LEVERAGING INSTRUCTIONAL TECHNOLOGY AND ASSET-BASED PEDAGOGY
FOR EQUITABLE REPRESENTATIONS IN TECHNOLOGY OPPORTUNITIES

A Dissertation
by
REBECCA H. BURRY
&
KIMBERLY A. NAVA EGGETT

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Abstract

LEVERAGING INSTRUCTIONAL TECHNOLOGY AND ASSET-BASED PEDAGOGY
FOR EQUITABLE REPRESENTATIONS IN TECHNOLOGY OPPORTUNITIES

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This dissertation explores the use of an asset-based lens to leverage instructional

technology in order to shift pedagogical practice in consideration of every student. This is a

series of co-authored articles by Instructional Technology Facilitators Kimberly Nava Eggett

and Rebecca Burry. Two articles are co-authored and two articles are written by individual

authors. The purpose of their writing is to explore instructional technology through the

theoretical foundations of Feminist and Critical Race Theories in order to explore the

intersectionality of these lenses. The first article centers their role as Instructional

Technology Facilitators (ITFs) as the co-authors have determined that technology is not

being utilized effectively in K-12 classrooms to actively facilitate equitable representation in

instructional technology opportunities and STEM roles. This co-authored piece will inform

the reader of how instructional technology and STEM opportunities that K-12 students have can hinder or give voice to historically underrepresented students, depending on how teachers and coaches choose to center student strengths and assets. The second article is a literature review as the co-authors seek to reflect on current pedagogical practice with regards to instructional technology and STEM with specific attention to women and students of color. The final two articles focus on the methods and results of the individual researchers' findings. Both ITFs worked with a group of teachers in order to work through a Coaching Work Plan that connected students' strengths with NC Standard Course of Study Standards and Digital Learning Standards for Students. Coaches were either observers or co-teachers as they worked closely with classroom teachers and students during a specified unit or lesson. Though they are using the same qualitative and quantitative methods, Nava Eggett and Burry will render that data through a Critical Race and Feminist Theory lens, respectively. Each article is brought together by a reflective bridge in which the co-authors were able to describe their process and reflections as well as provide contextual cohesiveness. Finally, the last section allows for the co-authors to describe and reflect on their process as they navigated the collaborative dissertation process.

Acknowledgments

We would like to take this opportunity to thank those that supported us along the way. Many folks outside of a doctoral studies program do not realize the energy needed to sustain this work and we are grateful for our partners, children, parents, colleagues, co-workers, and friends who provided us with words of encouragement.

Acknowledgements from Burry

I would first like to acknowledge my parents, Mike and Arnette Hannon, who have been my biggest supporters throughout my life and educational journey. Their unwavering support and encouragement has given me the confidence to even pursue this degree. To my husband, Brad, I can't thank you enough for ensuring me that I can do this. In the times when I doubted myself you were always there to remind me, "You've got this!" My daughter, Caroline, you are my driving force. I want to encourage you to always follow your dreams no matter what they are. To my brother in-law, Eric, your continued caffeine support via Starbucks and addressing me as "Dr. Becky" has pushed me to finish so I can officially be Dr. Becky. Finally, I would like to acknowledge the educators I have worked alongside over the past 15 years. My classroom experience and collaboration with each of you over the years has been my driving force to understand how we can create an equitable space for all of our students to learn and feel successful.

Acknowledgements from Nava Eggett

I would first like to acknowledge my mother, Camerina Nava Gutierrez, who raised me to be proud of our Mexican roots and always whispers, "Échale ganas, mija," as I continue to navigate bicultural lines and bilingual worlds. Gracias por su apoyo, amor, y gran ejemplo de mamá y mujer independiente. Su amor siempre sostiene todo lo que hago. To my

spouse, Stephen, thank you for your words of affirmation, love, and for holding it down at home while I was up to my eyeballs in writing and meetings. To my children, Jude and Amelia, who were taught to say, "You can do hard things!" when things got tough. I hope that you see that you can do hard things too! I'm proud of how resilient you both have been during this time. To my sister, Mariana, for understanding the hill we each had to climb to find our way, but for encouraging each other as we did. I'm proud of how far you've come. Mija, we are worthy! To the many colleagues, family, and friends that were personal cheerleaders when things were challenging, thank you for your support and time. May this work acknowledge all of the hours educators and leaders put into their days in order to ensure they are providing the best they possibly can for every single student.

We would both like to thank our dissertation chair, Dr. Patrick O'Shea and Director and Professor of Educational Leadership, Dr. Vachel Miller, for supporting us as the first to complete a collaborative dissertation at Appalachian State University as well as giving us space to push the boundaries! We would also like to acknowledge our dissertation committee members, Dr. Amy Washburn, Dr. Tracie McLemore Salinas, and Dr. JuanEs Ramirez. Each of them worked with us throughout this process offering guiding support, their unique lens, and reassuring encouragement. We are so grateful for all of you in supporting us on this journey.

Finally, we are thankful to have been a part of Online Cohort #1 (We're #1!) in the Educational Leadership Program at Appalachian State University. Our connection in a completely virtual environment allowed us to make meaningful relationships, especially during a global pandemic, with their resilience, brilliance, and community as we refined our leadership practice.

Dedication

This collaborative dissertation is dedicated to all public school educators, teachers, coaches, and administrators that continue to push against a system that does not serve all students equitably.

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Chapter One: Collaborating for Change and Setting the Stage

Wheatley (2008) states, "a leader is anyone willing to help, anyone who sees something that needs to change and takes the first steps to influence that situation" (p. 1-2). As educational leaders, we have had the pleasure of embarking on an innovative approach to a dissertation at Appalachian State University through co-collaboration. Through our individual lenses, we discovered ways in which technology can be transformational for classrooms and in our roles in K-12 organizations. We recognized that being the first to complete a collaborative dissertation at Appalachian State University required strategic planning, intentional collaboration, and careful consideration to ensure that in the end we both are representing ourselves as doctoral graduates and the Reich College of Education well. In this chapter, we state our reasoning behind a collaborative dissertation, introduce ourselves and our lenses, describe the collaborative dissertation deliverables, and share what to expect from the following chapter.

Why a Collaborative Dissertation?

Our decision to collaborate on our dissertation was unique and offered us the opportunity to broaden the depth and perspective of our instructional technology study. We offered similar yet diverse perspectives of how instructional technology can be integrated into classrooms with a focus on accessibility to all students. We also come from vastly different districts in North Carolina with regards to how our position as Instructional Technology Facilitator (ITF) is utilized and are often comparing how our roles do or do not

benefit teachers and students. As co-authors, we explored the intersectionality of our individual identities and roles in instructional technology, while uncovering how technology can be used as both a tool of oppression and liberation.

Since our coursework began in 2018, we found ourselves in the unique position of being the first ones in the Instructional Technology Leadership cohort and, therefore, were paired up for assignments often. As isolating as doctoral work can be, being part of the first online cohort and being one of very few instructional technology educational leadership doctoral students, allowed us to lean on each other, and, in turn, get an opportunity to build meaningful professional relationships. Professors would have students work in pairs or small groups to discuss or synthesize our work in order to make the content more meaningful and engaging. The idea of doing a dissertation on our own seemed daunting after spending months working and processing with others. We felt that our professional relationship allowed for us to continue research that interested us both, but we also knew what we could expect from each other. Doing a collaborative dissertation required being on the same page, holding each other accountable, and having a meaningful connection to the work.

We look forward to how our work together can be a possibility for others and appreciate the opportunity in creating a space for collaboration. We are grateful for the trust and support from Appalachian State University, especially from the members of our committee, to try new things as we refined our skills as researchers and leaders for our respective communities.

Who Are the Co-Authors?

Burry

From a young age, I aspired to be an elementary school teacher. I remember sitting in my elementary school classrooms and observing the way each teacher led class and interacted with students. I knew that my goal was to become an elementary teacher and return to my childhood school and teach. After completing my undergraduate degree, I did just that! Returning to my childhood school fulfilled my career dream as well as provided an environment to be supported by former educators at the start of my career. My first year of teaching was transformational for my career. I recognized the importance of a support system and mentorship aided in the success for myself and my students.

I continued teaching in the elementary classroom for the next 8 years as a 3rd grade, 1st grade, and 2nd grade teacher. In 2012, I began working on my master's degree in Educational Media at Appalachian State in order to teach elementary technology. At the completion of my degree, I taught in a computer lab setting, which transformed into a STEM lab for the next 8 years. Recently, I have accepted a position as a Digital Teaching and Learning Coach for my school district.

My early knowledge and the impact that mentorship played in my career inspired me to continue my learning and growth in leadership. Coupled with my passion for technology and desire to support educators, I began working on my Ed.D. Throughout the process, I have not only learned how to create inclusive spaces in education, but I have also learned how I fit in those spaces and what I bring to them.

Nava Eggett

With the support of the North Carolina Teaching Fellows scholarship at UNC-Asheville, in 2006, I became a classroom teacher in an urban district in Western North Carolina that I continue to work in today. I began my career as a 4th grade teacher and then transitioned to being a 5th grade teacher in a different K-5 public magnet school within the same district. After a few years of working as a classroom teacher, I found myself supporting others with the use of technology and often enjoyed integrating it in my classroom. In 2010, when Google tools were still new to education, our class had its own blog. Students would complete a typed post of their independent reading and have an audience to read their written work. I was inspired to pursue my Master's in Educational Media and, in 2012, I was able to step into an Instructional Technology Facilitator position in the same school. Ten years later, I am still in the same role and have continued to refine my coaching.

Over the last several years, I have completed independent work with our school-based Instructional Facilitator, Molly Peeples, to guide our coaching skills through *The Art of Coaching*, *The Art of Coaching Teams*, and *Coaching for Equity* by Elena Aguilar. As coaches, we are often not given tools to transition from being a classroom teacher to a coach. I also recognize that my lens as a white bilingual Latina in a technology role gives me an opportunity to shift normed expectations of what it means to be "good with technology." In an effort to continue to refine my leadership role, I decided to pursue an EdD, which I anticipate will further develop how I serve teachers and students in order to ensure educators and leaders can provide and sustain equitable learning environments.

The Intersectionality of our Work

      Both of our lenses and experiences in instructional technology allowed us to bring depth and understanding to the role of what it means to be an Instructional Technology Facilitator in North Carolina. It is through an intersectional lens that we were able to strengthen our understanding of coaching and what it means to lead and support others with our work. As we strive to be intersectional in our feminist lens, we found a natural overlap between our respective theoretical frameworks of Critical Race Theory and Feminist Theory. Though we initially thought that we would have vastly different outcomes when applying our theoretical framework to our research, we quickly found how we were complementing each other by ensuring that we were considering all identities, not just race or the gender binary. The intersectional space that connected our lenses strengthened our coaching moves as we investigated the inequities that exist in classrooms. Our individual lenses allowed for deeper conversation to how we each saw a coaching conversation or teaching move in a classroom, which allowed for us to better meet the needs of our teachers and students in our respective districts.

Instructional Technology is Not Inherently Neutral

      Considering how our classrooms reflect the greater society, implicit biases that are steeped in patriarchal and white supremacy culture can show up in pedagogical practices. This dissertation looked at how these biases show up within classrooms and it is through our Feminist and Critical Race Theory lenses that we as coaches can critically evaluate who is being excluded, whether it is implicit or explicit. For the purposes of our work, we intentionally consider both race and gender as identifiers that may exclude students from access to instructional technology or be held to a lower standard in the implementation of a

technology-rich lesson. Though race and gender are explicitly considered, these are not the only identifiers that surface in our work. This allowed us to consider equitable representation in instructional technology opportunities and STEM roles in our problem statement.

Research Questions

Our experiences as students, former classroom teachers, and Instructional Technology Facilitators in North Carolina were the main driving force to our problem statement, where we felt that **technology is not being utilized effectively in K-12 classrooms to actively facilitate equitable representation in instructional technology opportunities and STEM roles.** To further investigate this problem, our research questions are as follows:

1. What is the role of the instructional technology facilitator in supporting teachers as they use technology to facilitate equitable representation in STEM, both in opportunities and future career pathways?

2. How can an instructional technology facilitator support a teacher in evaluating their pedagogy through an asset-based lens?

3. In what ways can a meaningful learning partnership be cultivated between an instructional technology facilitator, teacher, and student by collaboratively developing a lesson that centers students' voice and choice?

These questions guided our work and helped us unpack the complexities of our problem statement, but also gave us an opportunity to carefully consider ways that we can leverage the role of the Instructional Technology Facilitator to cultivate equitable STEM opportunities and learning environments. Our main goal was to utilize our collaborative dissertation work to inform our professional work, but also shed light on tangible best

practice for other ITFs that seek to support schools in order to cultivate inclusive and responsive learning environments.

Collaborative Dissertation Description

In the form of deliverables for our dissertation, we chose to prepare four total articles for publication. The decision to pursue publication articles versus traditional dissertation chapters hinged around our future career goals. We would both like to pursue careers in higher education, where publications will play a role in our work. As we completed our doctoral studies, having four articles ready for publication will not only prepare us for our future careers, but will also offer a way for us to share our work in the field of instructional technology.

We collaboratively wrote this foreword, two publications, and the reflective bridges that serve as building context for the purpose of the dissertation between publications. During our writing, we had to be cognizant of the audience for each chapter and our dissertation work as a whole. As we prepared articles for journal submission, our intended audience were educators in the field. We wanted to provide a way for them to learn from our work and be able to apply this knowledge to their classroom. In our reflective bridges, we wove our writing together to connect our work as a dissertation deliverable. The reflective bridges were written in first-person point of view while the articles were written from a third person point of view. In order to ensure our articles would be accepted for publication, we made sure those articles were written in a third person point of view was used. Collectively, our work provides an insight into how to create an equitable classroom learning environment that offers all students the opportunity to experience integrated technology.

The first publication is framed around our problem statement, which states that technology in K-12 is not utilized effectively in order to ensure that the narrative of who can be successful in technology and STEM is disrupted. For this article, Nava Eggett was the primary author and Burry was the editor, and we selected the *Journal of Interdisciplinary Teacher Leadership* (JoITL). This publication is part of the Kenan Fellows Program for Teacher Leadership at North Carolina State University, which prioritizes STEM topics. We felt that this journal would reach educational leaders in both K-12 and higher education with an interest in instructional technology and STEM.

The second publication is a literature review with Burry as the primary author and Nava Eggett as the editor and it includes our individual interests of Feminist Theory and Critical Race Theory within STEM, especially technology. The purpose of this article was to showcase what we do know about STEM and instructional technology, including how women and BIPOC students are centered, but also to define the gaps in the literature that we addressed through our own research work. For this publication, we selected the *Journal of Educational Technology and Society* (ET&S). We chose this publication because it not only focuses on educational technology but also on how technology can be integrated into classroom curriculum to enhance learning for students. How we addressed the gaps in the literature regarding asset-based learning, along with technology integration, would be meaningful for this journal and educators reading this journal as well.

The final two articles are an in depth look through our individual lenses of Feminist and Critical Race Theory, which analyzes the problem statement through our independent, but shared methodology and data collection. These two articles were written independently with one author responsible for each, but connecting to the framework and methodology

outlined in the first two collaborative articles. For these publications, we selected *Issues and Trends in Learning Technologies* (ITLT) and The *Elementary STEM Journal*. Nava Eggett selected *Issues and Trends in Learning Technologies* (ITLT) as it was looking for submissions on innovative pedagogy and offers a space for educators to consider both theory and practice. Burry selected *The Elementary STEM Journal* because the focus of this journal is on how to put theory into practice in the STEM classroom. This journal offers the opportunity to share our data on girls in STEM opportunities and roles in an elementary setting.

As we answered each of the three questions in our individual articles, we shared the same data set from both our districts, but offer our own Feminist or Critical Race Theory Lens. Since we wrote our own article for articles three and four, dissertation readers will see the data twice, but will be offered a different perspective in each article. We concluded our dissertation work with a deep reflection chapter delineating our collaborative dissertation journey. The purpose of the final chapter was to share the advantages and disadvantages of completing a collaborative dissertation, including our process and what we learned by doing this work together.

Podcasting to Document Our Journey

Since May 2021, we also captured our process and reflections with a podcast called, "Through Our Lens" (Burry & Nava Eggett, 2021-present). This podcast was solely for documentation purposes of our process and a way for us to stay on target with our work, but not necessarily to be used as a deliverable for our dissertation. We used this space and time to process our thinking with each other, as well as with others. We were able to interview each of our dissertation committee members as well as fellow EdD students with the hopes that

technology could be used to share our process and stories, especially for those that have been underrepresented in EdD programs. Being trailblazers by completing the first collaborative dissertation at Appalachian State University as well as the first EdD students with a concentration in Instructional Technology was daunting. Our gender, racial, and ethnic identities were a unique lens that informed our leadership and how we navigated our doctoral work. We hope that these podcast episodes can demystify the mysteries of dissertation work, but also shake away the imposter syndrome that can come when navigating higher education spaces.

As we each worked to complete the articles, gather our data, present our findings, and collaborate with our committee members to complete a dissertation defense, we also built a professional relationship without seeing each other face-to-face. As full-time Instructional Technology Facilitators, adjunct professors, mothers, and spouses, technology enabled us to collaborate and communicate in ways that did not require us being physically in the same space. We are grateful for the ability to have technology at our fingertips to complete meaningful work and to cultivate a strong professional relationship as we live in different parts of North Carolina. Our articles and work in the field wove together a common thread of representation through instructional technology from two very different communities.

Looking Ahead to Chapter Two

In the following chapter, we focused on the problem statement as it was the driving force behind our work. This chapter will be sent to the *Journal of Interdisciplinary Teacher Leadership* (JoITL). Since our problem statement states that **technology is not being utilized effectively in K-12 classrooms to actively facilitate equitable representation in instructional technology opportunities and STEM roles**, we felt that this publication

would connect with the publication's mission and audience. To provide more context on why equitable opportunities and representation in STEM and technology through inclusive and culturally responsive pedagogy takes the center stage in this writing, it is important to understand the relationship that we have with these domains. We have often discussed how our career pathways could have been different had we considered STEM earlier. We both currently serve as ITFs in two different districts in North Carolina and the ITFs role is to coach and mentor teachers on how to integrate technology into their classroom curriculum. One of the primary ways to guide educators on technology integration is through professional development training and one-on-one or small group coaching. As a bilingual Latina growing up in Western North Carolina, Nava Eggett rarely had an educator who felt like a reflection of herself and never considered STEM as a possibility. As a white female student, Burry did not often see female role models leading STEM in K-12 spaces either. If anything, the narrative of "not being good at math" was something we both felt, even though we now lead introductory computer science and coding puzzles for students to solve. Our hope is that our work will lead to educational leaders critically evaluating the disparities that exist in learning environments.

Chapter two will define STEM, Culturally Responsive Teaching, Universal Design for Learning (UDL), both Feminist and Critical Race Theory, and our roles to set the stage for our literature review. It also states the research questions that guided our individual methodology chapters in order to keep us as co-researchers connected while processing our work through our respective theoretical lenses and experiences. It is important to note that there is redundancy in our definitions as these chapters are set up to be published as individual articles. Though the reader of this dissertation will see repetitive definitions, the

individual articles require these sections as standalone sections. We felt it was especially

important that in depth definitions of Critical Race Theory were necessary in each article that

mentioned it in order to continue to dispel misinformation that has launched CRT into non-

academic spaces. The problem statement uncovers the intersectionality of our work and

demonstrates ways that gender and race connect to instructional technology and STEM.

Chapter Two: Leveraging Instructional Technology Facilitators for Equitable and Inclusive Roles and Opportunities Utilizing Technology[1]

Instructional technology is an integral part of the K-12 learning environment, and it includes the software, programs, and physical devices needed to support an educational setting or to provide accessibility tools for exceptional students. As classroom pedagogy continues to shift and evolve over time, it is necessary to examine the influence of instructional technology in classrooms. This includes evaluating who can benefit or enhance their learning experiences with the intentional use of technology. How a teacher chooses to integrate technology or who has access to certain tools can shape how students perceive their learning potential. Students are constantly being given both implicit and explicit messaging on who can be successful when it comes to technology. Whether it comes from media imagery or who is teaching them computer science skills, representation has an impact on the continued evolution of who has access and, therefore, benefits from technology.

A culturally responsive educator is in tune with the needs of their students by shaping curriculum and instruction based on each student's assets and cultural capital (Hammond, 2015; Ladson-Billings, 2014). Cultural capital refers to everything from surface level cultural knowledge such as food, language, and music to deeper cultural knowledge like preferences for competition or cooperation (Hammond, 2015). Though the term *Culturally Responsive Teaching* is becoming more prevalent in the field of education over the last several years, it is

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[1] This chapter will be sent to the *Journal of Interdisciplinary Teacher Leadership* (JoITL)

still misunderstood by educators and underutilized in classrooms (Eakins, 2022; Ladson-Billings, 2014).

Culturally Responsive Teaching ensures that all students are seen, valued, and a part of a safe learning environment that is inclusive based on the diverse needs within the classroom (Hammond, 2015). Instructional Coaches, Instructional Technology Facilitators (ITF), administrators, and teachers are often driving pedagogical practice, including who is allowed to create and explore with technology. Teachers, both explicitly and implicitly, give certain students access to technology tools or activities, which continues to drive the confirmation of who can and cannot be successful with these tools. In this article, the authors will examine the need for inclusive and culturally responsive pedagogy in order to ensure equitable opportunities and representation in technology are provided to those that have been historically underrepresented. The authors utilized Feminist Theory and Critical Race Theory as the frameworks which names the urgency towards culturally responsive teaching and its role within the Instructional Technology Facilitator.

Problem Statement

Through their common experiences as coaches in instructional technology in K-5 elementary schools, the authors have often had the opportunity to communicate with one another on situations they have noticed. It is through these experiences with which we have determined *representation* as a recurring theme. Whether it be to ensure there is equitable access to technology in schools or support teachers as they are considering every single student in their classroom, these leadership positions can have a big impact on the schools they serve. Though these positions are designed to guide schools or districts in the implementation of instructional technology, an ITF's leadership can continue to perpetuate

inequitable practices or be an advocate for underrepresented voices. As scholars and women in technology, the authors are aware of the educational gap that exists for historically marginalized students, and educators recognize that there are far fewer women and Black, Indigenous, and People of Color (BIPOC) educators in STEM, which includes technology (Martinez & Christnacht, 2021; Ladson-Billings, 2013).

Technology and STEM

The STEM (Science, Technology, Engineering, and Mathematics) education movement started in the early 1980s, which was prompted by workforce and economic concerns and led to preparing students with an emphasis on science and mathematics. In 2001, the STEM movement began to emphasize the need for all areas of STEM to create a way for all U.S. students to be globally competitive incorporating science, technology, engineering, and mathematics. In 2010, the STEM educational movement became a highly sought-after trend, which focused on all students having this curriculum as an integral part of their learning (Breiner et al., 2012). Eleven years later, in 2021, The Pew Research Center indicated that 33% of STEM jobs in the United States were held by non-white individuals (Fry et al., 2021). They also found that although women accounted for almost 50% of the STEM workforce, a quarter or fewer of them were in computing and engineering and most women were in healthcare jobs (Fry et al, 2021). Equally as important, girls and students of color are not pursuing STEM related fields of study or careers. The Women, Minorities, and Persons with Disabilities in Science and Engineering 2021 report states:

Women's highest degree shares across all three-degree levels (bachelor's, master's, and doctorate) were in psychology and biological sciences. Agricultural sciences had high shares of women earning bachelor's and master's degrees. Computer sciences

and engineering had the lowest degree shares of women. (National Center for Science and Engineering Statistics, 2021, p. 14)

The same report also states that, although the rate of science and engineering degrees awarded to underrepresented groups, such as Hispanic, Latinx, Blacks or African Americans, and American Indians students, have increased, they are still vastly underrepresented in relation to the overall population. The question, "what do you want to be when you grow up?" did not always reflect STEM options for both girls and students of color. Research has shown that girls, especially girls of color, were being excluded from curricula that did meet their gender qualifications due to stereotype threat (Saucerman & Vasquez, 2014; Sparks, 2016). A stereotype threat is defined as a student's negative perception based on external messaging based on negative stereotypes associated with their identities, including their gender (Hammond, 2015). The same could be said for students of color as the messaging that is reinforced when many STEM roles are held by white men and women. It was assumed that girls and students of color didn't fit the role of STEM careers, however, through the STEM education movement, gender and racial inequality was beginning to be addressed.

In a typical K-5 STEM class, students often utilize inquiry, hands-on learning, and design thinking in connection with real-world applications. STEM education develops a variety of skill sets including the 4Cs: communication, collaboration, critical thinking, and creativity (Stauffer, 2020). But access to STEM education is not readily available to every student due to resources or prioritization, nor is there an equitable representation of educators who are women and/or educators of color in STEM. This influences how students perceive their own place in the field of STEM, including computer science education (Code.org, 2021a; Martin & Fisher-Ari, 2021).

STEM strategic plans at state and federal levels often cite workforce needs or its influence on the economy, but do not focus enough on a shift in pedagogy to be more inquiry-based or hands-on rather than lecture-based teaching (North Carolina Department of Public Instruction, 2012). The focus on creating certain STEM graduates seems to come from a need to supply a workforce rather than cultivate curiosity or creativity. In this same vein, the authors acknowledge that STEM often embraces western science, but does not often include indigenous ways of knowing or collective learning (Eglash et al., 2020). By considering the various identities and strengths of students, educators can push against the narrative of what STEM should look like in classrooms and for the purpose of providing bodies for the workplace.

As gender continues to be referred to in this article, the authors want to note that the use of the terms "men," "women," "girl," or "female" are binary terms that are often used when noting a gender gap and want to acknowledge the transgender and non-binary students that are often left out of the narrative. The term 'gender gap' is defined as the difference between binary genders of male and female and how it is reflected in social, political, and intellectual opportunities (Cimpian et al., 2020). Although those are the terms that were used in order to find research to support the problem statement, the authors acknowledge the inequities that exist for LGBTQIA+ students in STEM and technology and they are not trans exclusionary in their feminist lens. Gender, along with the multitude of identities that affect daily lives, is a piece of the intersectional feminist lens when considering STEM roles and opportunities.

Intersectionality of Gender and Race in Instructional Technology

The collaborative work of the authors and their roles as instructional technologists has brought their interests of race and gender to the forefront of their conversations. The term 'intersectionality' surfaced in the 1980s and was coined by legal scholar Kimberlé Crenshaw. Crenshaw says people have multiple identities that intersect along with race that can affect a person's reality (Carbado & Crenshaw, 2019). Gender, class, religion, language, immigration status, dis/ability, and sexuality all add layers to a person's lived experience beyond race. This includes a student's daily life in the K-5 classroom and how their teacher chooses to center (or not center) their identities as part of pedagogical practice. Additionally, STEM and technology are often seen as colorblind and monocultural. STEM values certain work pathways that can further perpetuate classist expectations by highlighting certain jobs such as engineering or computer science. Utilizing a feminist and critical race lens offers an opportunity to collaboratively explore how educational leaders and ITFs can change current pedagogical practice with the use of technology in their roles as they support classrooms.

Every day is an opportunity for educational leaders to leverage their privilege within their schools and districts. Though the normed societal narrative does not make it easy, checking individual implicit bias to facilitate and support the integration of instructional technology with intentionality is crucial. Recognizing the inequities in opportunities that exist for girls and BIPOC students in technology and STEM education leads to the following problem statement: **Technology is not being utilized effectively in K-12 classrooms to actively facilitate equitable representation in instructional technology opportunities and STEM roles.** For the purpose of this writing, the authors have named "instructional technology opportunities and STEM roles" as access to STEM skills and technology tools in

K-12 classrooms as well as how these opportunities correlate with STEM higher education and career pathways.

Research shows that exposure to STEM curriculum and activities in K-12 can influence future STEM pathways (Mau et al., 2020). If technology is not being used effectively in K-12 classrooms in an inclusive way, educators and educational leaders will further drive inequitable outcomes in STEM and technology. Social Identity Theory suggests that individuals self-categorize in three stages: social categorization, social identification, and social comparison. Steinke et al. (2021) found that in Social Identity Theory, "individuals are most likely to associate or identify with social groups they view as most positive based on comparisons of in-groups and out-groups" (p. 3). Students who identify with multiple social identifications could perceive intergroup conflict when viewing STEM role models and professionals in a traditionally stereotyped way. Examining pedagogical practice through critical self-reflection as educators and educational leaders can help make tangible progress towards the inequitable outcomes that currently exist for girls and students of color in K-5 classrooms.

Research also demonstrates that teachers can convey math anxieties to their students, which can affect their math performance and interest to continue pursuing mathematics through implicit messaging (Saucerman & Vasquez, 2014). These personal experiences have led the researchers to ensure that the work that they lead is equitable and inclusive. Their hope is to use their positions of leadership and privilege to shift the narrative on who engages with STEM. Collaboratively working together requires understanding and consideration of each unique perspective. Together, they can provide a comprehensive look into what can be

challenged about instructional technology and how it can be improved in order to empower all students.

As part of the North Carolina Instructional Technology Evaluation Process, Standard II states, "Instructional Technology Facilitators build a learning environment that meets the instructional needs of all students" (North Carolina Department of Public Instruction, 2015, p. 51). ITFs are tasked with being reflective in their practice in order to be inclusive of the diverse needs of all learners. These pieces of the ITF's evaluation process demonstrate how crucial this role can be in leveraging technology effectively. Acknowledging the goals of the evaluation instrument can help center the work of the ITF as an asset to a school community in ensuring that instructional technology is being used effectively and inclusively. By utilizing both of their perspectives and expertise from Feminist and Critical Race Theories, they are able to unpack why technology is not being utilized effectively in K-12 classrooms to actively facilitate equitable representation in instructional technology opportunities and STEM roles.

Culturally Responsive Teaching

As Bruner (1986) suggested, "we live storied lives, and for educators, the stories we tell shape what could be" (p. 485). Bruner was referring to the pivotal role educators play in the educational system as a whole. Every day, an educator's teaching moves and interactions has the potential to influence a student's educational story and their career pathway. Teachers can impact a student's educational life and their own story from elementary through post-secondary studies. As ITFs themselves, the authors have witnessed students thrive in a STEM facilitated activity. In these opportunities, students that had never been considered as leaders in their classroom before were able to demonstrate their underutilized assets and

flourish in STEM related activities. For example, when co-author, Nava Eggett, asked second through fifth grade teachers to provide two students to be trained as student technicians to support their classroom, they provided boys, with a vast majority of them being white. It is likely that their implicit bias of STEM leadership assumed that a girl or student of color might not be interested or successful. When asked to reflect on both the gender and race of the recommended students, teachers were able to revise their recommendations and acknowledge the impact their biases had when considering classroom helper roles. Noticing how implicit bias affects simple decisions, such as determining who is seen as a 'tech expert,' can confirm positive or negative views students have of themselves.

Stories like the one described above become part of our educational story. These stories not only become part of our memory, but they can influence the way a student learns and interacts in their educational environment. Just like instructional technology should not live only in computer labs, culturally responsive teaching should not be limited to certain content areas or BIPOC educators only. Chuang et al. (2020) echo with, "professional training and pedagogical modelling of technology use, especially in classrooms with culturally diverse students, is highly recommended" (p. 2443). They continue to state that the more exposure to technology-related experiences, the more likely educators are to modify their teaching practices to support their culturally diverse students.

Initially grounded in supporting neurodiverse students, Universal Design for Learning (UDL) is a framework of research-based practices that guides teachers through pedagogical decision making (Kieran & Anderson, 2019). UDL gives teachers the opportunity to reflect on their pedagogy to ensure that learning is purposeful and engaging, but also gives students strategies on how to be resourceful and goal-oriented (CAST, 2018). Its approach is to

consider all students' learning needs and goals and to steer away from 'one-size-fits-all' lessons and units. Utilizing UDL does not mean pedagogy will automatically be culturally responsive. By reviewing experiences with race and ethnicity in mind, educators are intentional and open to a counternarrative in normed experiences. ITFs provide professional development for educators on how to incorporate technology into their curriculum. Planning innovative change, such as integrating technology, requires purpose and vision. Understanding how technology integration is currently being conducted can lead to the necessary changes needed to address how students can utilize technology in their learning spaces equitably. Utilizing Feminist and Critical Race Theories as the grounding framework can help leaders examine how technology integration has impacted student learning in the elementary classroom.

Theoretical Framework

As co-researchers, each author has unique perspectives, experiences, and positionalities with educators from our respective districts, and supports their K-5 students with an intentional focus on girls and historically marginalized students. Through a Feminist and Critical Race Theory framework, the authors chose to center historically underrepresented students in order for other ITFs to be reflective of their teacher and student support with an intentional focus on asset-based strategies.

Feminist Theory

The word feminism can be misinterpreted as rebellious women who loathe men. Although this common myth about feminism is a normed narrative, feminism means the opposite. Feminism has been described in many ways, but Ahmed (2017) found a way to gracefully pen the meaning in her book, *Living a Feminist Life*. She writes, "It [feminism] is

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a word that fills me with hope, with energy. It recalls the loud acts of refusal and rebellion as well as the quiet ways we might have of not holding on to things that diminish us" (p. 1). hooks (2000) suggests feminism is, "a movement to end sexism, sexist exploitation, and oppression" (p. ix). Both feminist theorists suggest that feminism is not women hating men or women refusing to be women. Instead, they suggest feminism is a way to build each other up and address inequities between all genders as a society.

Why does feminist theory matter and what difference does it make? Feminist theory is an extension of feminism discourse. It also examines the roles women have in society. The main purpose of feminist theory is to understand the nature of gender inequality. The aim of feminist theory is bettering women's lives. Grosz (2010) concluded:

Feminist theory is not only about addressing the rights and wrongs of women, those done to women and made by women, in the past and present; it is also, perhaps above all, about addressing how these wrongs can be transformed, how a better social system or structure might be brought into existence than what is currently available. (p. 101)

Feminist theory can be divided into three broad perspectives: social, reformist, and radical feminist. In order to examine the gender gap in STEM education and careers, the authors will be utilizing the reformist feminist theory perspective which works to transform the system and to put an end to patriarchy and sexism (hooks 2000, p.4). Understanding how girls view themselves not only in the classroom environment, but in society as well will provide insight as to how to overcome these barriers in STEM education.

Feminist history can bring awareness as to what feminism has achieved and where the work needs to continue. Feminist theory embraces the historical achievements and challenges

of the feminist movement and utilizes the lessons learned to provide a critical lens for work going forward. By applying a feminist theory lens to the current gender gap in STEM education and careers, the co-researchers can identify ways that K-12 instructional technology pedagogical practices contribute to this inequity. Feminist theory also enables researchers to seek changes on the behalf of women and girls. Identifying areas in which female representation in STEM can be promoted is key to closing the gender gap. Utilizing a feminist framework will help address the female representation in STEM and the contribution women can add to the STEM profession. The US Department of Commerce Executive Summary explains:

> Our science, technology, engineering and math (STEM) workforce is crucial to America's innovative capacity and global competitiveness. Yet women are vastly underrepresented in STEM jobs and among STEM degree holders despite making up nearly half of the U.S. workforce and half of the college-educated workforce. That leaves an untapped opportunity to expand STEM employment in the United States, even as there is wide agreement that the nation must do more to improve its competitiveness. (Beede et al., 2011, p.1)

When evaluating how the United States compares to other countries, there is a need for more growth within STEM careers. The female perspective in these fields is missing and including voices and ideas that have been historically absent will only enhance the current work. Moss-Racusin et al. (2018) found in their study on gender gaps, "they [women] 'choose' to engage at lower rates than men only in the presence of systematic biases against them" (p. 667). Creating a space for female voices to be heard is crucial. Due to the existence of gender bias in a variety of roles in society, it is not surprising gender bias also exists in STEM

education and careers. Evaluating gender bias in STEM includes discovering the misconception and perceptions that have existed. Though ITFs do not work to find the root causes of gender biases in their daily work, using a feminist lens does provide an opportunity to reflect on how educational leaders can create a classroom environment and curriculum change in STEM to create a space for all student voices in their learning. Gender is one aspect of our individual identity to explore as race and ethnicity are also factors to consider when exploring instructional technology in K-12 education through an asset-based lens.

Critical Race Theory

Social constructionism establishes that knowledge and understanding of the world is developed by learning from one another. This includes societal norms and expectations as well as individual experiences that are grounded in their reality, and are, therefore, known as true. As stated by Esterberg (2002), meanings are created out of social interactions and changed through interpretation. Because these realities are socially constructed, it is vital for the researcher to interpret the realities with a focus on how they were produced.

Critical race theory (CRT) is both a methodology and theory that builds knowledge based on a social reality defined by individual experiences, and it gives voice to emancipate historically marginalized groups. This framework allows researchers to critically evaluate pedagogical practices in instructional technology by centering race as its lens and acknowledges that educators have a role in either perpetuating or combatting the structural oppression that can be detrimental to both educators and students of color. There are five tenets that are utilized in Critical Race Theory that guide scholarship, pedagogy, and perspective: 1. Centrality and intersectionality, 2. Challenge dominant narrative and differential racialization, 3. Commitment to social justice and interest convergence, 4.

Experiential knowledge and counter-storytelling, and 5. Historical context and interdisciplinary perspectives (Solorzano, 1998; Delgado & Stefancic, 2012; Han, 2019).

Centrality and Intersectionality. CRT acknowledges that race and racism are inescapable as social constructs that are a part of society. It is important to note that although CRT's purpose is to emancipate as it centers race, the theory states that there will always be oppressive structures in place with inequities between the dominant and marginalized groups (Parker & Roberts, 2011).

Challenge the Dominant Narrative and Differential Racialization. As BIPOC voices have been historically underrepresented, CRT urgently reminds researchers that the dominant narrative often misrepresents or does not represent those that are not white. Identifying normed experiences validates the loneliness or microaggressions people of color endure as they seek to live their lives (Hubain et al., 2016). CRT critiques the social, cultural, and psychological assumptions of the societal structure with the purpose of emancipating the oppressed (Merriam, 2002). Differential racialization, which posits that "groups of people are racialized in differing ways at differing times" in order to benefit whiteness (Basile & Black, 2019). For example, Mexican migrant workers were sought after by the labor market, and, therefore, the United States created a temporary Bracero Program from the 1920s-1960s, that would allow for cheap, temporary labor (Delgado & Stefancic, 2012; Ortiz, 2018). This meant that Mexican migrant workers were desirable, especially since they could be repatriated without due process and be replaced at any given time. In this case, keeping certain groups of people marginalized, whether explicitly or implicitly, continues to protect the concept of white supremacy.

Commitment to Social Justice and Interest Convergence. CRT researchers acknowledge that their work exists in educational spaces that function in paradoxical ways with "their potential to oppress and marginalize coexisting with their potential to emancipate and empower" (Solorzano & Delgado Bernal, 2001, p.313). As white supremacy and colorblind practices are noted and scrutinized, there is potential for resistance, and, therefore, a commitment to social justice is crucial for CRT researchers. Interest convergence also warns researchers that a commitment to social justice may be influenced by groups of people if it benefits them as well.

Experiential Knowledge and Counter-storytelling. Experiential knowledge is central to CRT and links this knowledge to interpretive perspectives on race and racism (Parker & Roberts, 2011). Experiential knowledge is valued and trusted within Critical Race Theory as it provides insight based on lived experiences and values cultural representations through an asset-based lens (Parker & Roberts, 2011). As stated by Solorzano and Yosso (2002), these stories include methods such as "storytelling, family histories, biographies, scenarios, parables, cuentos, testimonios, chronicles, and narratives" (p. 27).

Historical Context and Interdisciplinary Perspective. Historical context, as well as having a variety of perspectives, helps give a better sense of an issue or story. CRT in education uses an interdisciplinary perspective and methodology by incorporating research from ethnic studies, Women's studies, history, law, and education to better understand the intersectional needs of marginalized groups (Solorzano & Yosso, 2002).

The theoretical framework of CRT informs the perception of technology and instructional technology as race-neutral and inherently good in schools and communities. CRT offers a critical lens that acknowledges race and social structures are systematically

perpetuating oppressive systems that continue to disempower underrepresented groups such as women and people of color (Denzin & Lincoln, 2011). Technology in education is no exception; it must be explored, evaluated, and critiqued through a lens that questions how race plays into its development and use.

Though she is not the only Critical Race Theorist in education, the heart of Ladson-Billings' work focuses on how teachers can recognize the assets of their African American students with practical teaching strategies. When she first started her research in the 1990s, she found that academic searches about African American students led to terminology like "at-risk, disadvantages, and underachieving" and lacked language surrounding African American academic excellence (Ladson-Billings, 2014). CRT gives language around oppressive systems such as educational systems and how those systems perpetuate white supremacy. In her writing in 2014, Ladson-Billings acknowledges that the terminology around culturally responsive pedagogy has varied definitions and that "scholarship, like culture, is fluid [...]" (p. 75).

That fluidity has recently placed CRT as part of news headlines as society grapples with new terminology such as structural racism, implicit bias, and social movements like #BlackLivesMatter. The #BlackLivesMatter movement began in 2013 when a group of women decided to use a hashtag to highlight the injustices and violence that exist for Black people after the acquittal of murderer of Black teen, Trayvon Martin (Ruth, 2021). Hashtags and social media have been used as tools for highlighting social justice issues, but they have also been used to share misinformation on #BlackLivesMatter and Critical Race Theory. Whether or not CRT is being understood correctly by people outside of academia, it is being

used as a divisive tactic to avoid discussing race, structural racism, and changing curriculum to better reflect all students (Camera, 2021).

Differential racialization could also be applied with diversity hires, where school districts or STEM organizations push to recruit women or BIPOC candidates in order to appear "more diverse," but continue to keep those in decision making spaces as predominantly white and male. Scholars and educators that understand and utilize CRT can explore, define, and express how race is part of their research, learning spaces, and leadership. Education is not spared from the harm caused by white supremacy and this framework provides a needed discourse that centers race in order to dismantle white supremacy culture.

When considering experiential knowledge, CRT includes storytelling to utilize narratives and can be leveraged through instructional technology to guide student experiences (Pun, 2020). This lens allows researchers to critically evaluate pedagogy and acknowledge that educators have a role in structural oppression that is detrimental to students of color. Without CRT, researchers, educators, and leaders could easily dismiss certain voices by allowing normed experiences and expectations to control the narrative. Whether it be K-12 education, STEM education, or instructional technology, equity cannot be truly achieved if leaders are unable to evaluate their pedagogy and roles through a critical race lens.

Connecting Theory with Practice

As the co-authors grapple with how technology is used by classroom teachers, especially after several months of navigating virtual learning, they want to provide opportunities for their students to be engaged, reflective, and receive responsive feedback in

order to present their work in a way that feels meaningful to them. The problem statement identifies how technology is not being utilized effectively in K-12 classrooms to actively facilitate equitable representation in instructional technology opportunities and STEM roles. The following questions allow the researchers to evaluate the problem statement through their theoretical frameworks:

1. What is the role of the Instructional Technology Facilitator in supporting teachers as they use technology to facilitate equitable representation in STEM, both in opportunities and future career pathways?

2. How can an Instructional Technology Facilitator support a teacher in evaluating their pedagogy through an asset-based lens?

3. In what ways can a meaningful learning partnership be cultivated between an Instructional Technology Facilitator, teacher, and student by collaboratively developing a lesson that centers students' voice and choice?

These questions allow Instructional Technology Facilitators to dig deeper into the complexities of the problem statement as they consider culturally responsive teaching in their coaching and teaching. These questions carefully examine the role of the ITF to foster equitable STEM opportunities and safe learning environments. Reflecting on their role as an educational leader, an ITF can help leverage tools and pedagogy in order to make positive change in the current state of inequitable representation of women and BIPOC STEM roles.

Inequities in Technology and STEM Career Pathways

In order to guide learners to STEM fields, which leads to better representation in technology in general, it is important for them to see themselves reflected in the field. In reference to undergraduate studies, once students are in STEM classes, O'Hara (2020) states

that, "Students receive implicit and explicit messages from faculty inside the classroom that drastically impact their sense of belonging and their academic success in STEM programs" (p. 4). Cultivating culturally responsive pedagogy can help center the student in STEM and elevate future BIPOC STEM leaders rather than continuing to add to the societally normed expectation of white males or the "model minority" stereotype of Asian students as the most successful in STEM and technology (O'Hara, 2020; McGee et al., 2017). Valenzuela (2020) echoes this sentiment by stating, "Rather than an asset-based, non-deficit, approach, students get customarily sorted into a hierarchy of so-called 'ability' that tends to relegate minoritized females and males to the bottom and white males to the top" (p. 900).

Feminist scholar bell hooks (2000) states, "what we do is more important than what we say or what we say we believe" (p. 15). Reviewing research and studying how to close the gender and racial gap in STEM education is only the first step. Identifying change and then being an active part of that change is what is most important. The researchers' work in the field is to understand not only why the gender and racial gap in STEM remains, but to be part of the continuous change going forward. When young girls and students of color look back on their educational experiences and reflect on their story, it should be one that is filled with unlimited possibilities and opportunities. Whether they pursue the STEM field of study or career is not important, the most crucial part is that they had the choice. Allowing for equitable opportunities for STEM and instructional technology gives students the ability to decide whether STEM is for them rather than being excluded from it altogether. Making pedagogy relevant and connected to real-life experiences for girls and students of color requires a shift in approaching lessons through culturally responsive pedagogy.

Ahmed (2017) suggests, "To build feminist dwellings, we need to dismantle what has already been assembled; we need to ask what it is we are against, what it is we are for, knowing full well that this is not a foundation but what we are working toward" (p. 2). One statistic states that in 2020, there were 400,000 open computing jobs in the United States and those jobs are expected to be available at twice the rate as other jobs as the number one source of new wages (Code.org, 2021c). The push for STEM education is not just to address the economy, but also the inclusion of girls and students of color in STEM related fields. The dwelling that Ahmed referred to is the need for STEM education; however, the dismantling needed is how to create inclusivity for all.

Ahmed (2017) states, "Not naming the problem in the hope that it will go away often means the problem remains unnamed. At the same time, giving the problem a name does not make the problem go away" (p. 34). The goal is to identify the problem and work towards change that can offer opportunities for girls and students of color in STEM where they would not otherwise be introduced to the possibilities. Simply identifying the gender or racial gap in STEM education will not magically make it disappear. Deliberate steps must be taken to create the change needed.

One way is by examining what toys younger students are exposed to. A change in a doll, such as Barbie, can create a new exposure to women's place in STEM careers (Saucerman & Vasquez, 2014). Representation matters, so creating role models in the field will provide young girls with a visual representation of their possibilities. Integration of STEM education in the classroom curriculum starting in elementary school and continuing throughout the students K-12 learning can also influence the trajectory of a student's interest in STEM. It is important to introduce students to careers in the STEM field along with the

excitement STEM has to offer through problem solving and inquiry. Consideration towards existing inequities in STEM and technology allow educators to examine their own biases and acknowledge the biases that exist in technology and education.

Bias in Technology and Education

Our society and education system has normed innovation and technology, which includes educational technology and its use of data, as forward-thinking and a benefit for all. Speaking at a Data for Black Lives Conference, Dr. Ruha Benjamin stated, "We don't find data; we produce it" (Data for Black Lives, 2017). The researcher discussed the way technology has been leveraged to perpetuate oppressive results in society. This helps describe how people, as a society, not only construct knowledge, but also require the construction of that knowledge to better represent the variety of voices and perspectives.

Tech as Inherently Good or Neutral

Technology, data, and its perceived neutrality, especially within educational spaces, have begun to be critically examined by more and more people, especially those from historically underserved and marginalized communities in both education and technology. By considering how data is produced with the intentionality of inclusivity, a shift can be made societally to understand technology's inability to be neutral.

The normed discourse around technology often conjures up images of innovation, evolution, and forward-thinking approaches to many different aspects of our lives. As CRT declares that structural racism perpetuates inequities in society, Benjamin (2019) connects these inequities with technology and its use of data in her book, *Race After Technology: Abolitionist Tools for the New Jim Code*. By using the term "The New Jim Code," Benjamin (2019) explains how white supremacy has evolved from the Jim Crow rules of the Civil

Rights Era to a more implicit tool to disenfranchise and oppress people of color due to the nature of its creation. Technology perpetuates whiteness as the normed experience as it is a product of a field dominated by white males. Benjamin further explains that technology depends upon algorithms, or data sets, in order to follow and complete its commands. It is important to consider those data sets, including who created them, who will benefit from them, and who is excluded from them. One example that seems harmless is as simple as hand drying technology, where the automated hand dryer would not detect darker skin, but worked for light skin (Benjamin, 2019). The data sets used within the device's software was to detect a hand that had a certain lighter skin tone while making those with darker skin invisible. Though many may argue that this tool is just a coincidence not a malicious, intentional outcome, it is a reminder that colorblindness due to the exclusion of darker skin tones in data sets means that people of color are literally not seen.

Access Doesn't Equal Inclusive

As the nation transitioned to distance learning due to a global pandemic, many school systems sought out technology as a way for educators to approach schooling. This digital access, both at home and in school, requires educators and leaders to remind themselves: who is benefitting and will continue to succeed by default? During remote learning, computers became the vehicle for learning rather than its typical supporting role in the classroom. Due to cheaper and faster computers, as well as access to collaborative learning software such as Google for Education, school districts' access to technology has changed drastically over the last several years. As educational technology has evolved, its ability to enhance content and pedagogy has been seen as a positive innovation. As they seek computing as the key to academic achievement, districts throughout the country are praised for having a 1:1 model, in

which each student is equipped with a technology device rather than having a shared device, while those that have no access to technology are seen as being behind (Sutton, 2015). The pandemic forced many school districts to go 1:1 without necessarily having the training to ensure best practices were employed as the global pandemic forced educators and leaders to reckon with the digital divide. Pun (2020) states, "The digital transitions can and have paralyzed educators and students alike who may not have access to technological resources or the necessary technology skills to navigate the switch" (p. 2). In other words, having the access to technology does not inherently mean that all students will have the support to utilize and create with technology, especially if the pedagogy and content continues to perpetuate white supremacy culture.

In his presentation at the 2019 Texas Computer Education Association (TCEA) Conference, keynote speaker and educator, Ken Shelton, discussed the term 'Techquity.' He used this term to critically evaluate educational buzzwords like STEM and Project Based Learning (PBL), which have the perception of being, again, a 'silver bullet' of innovation for all students, when in fact it does not mean it is a culturally responsive learning experience for underserved students (Shelton, 2019). Encouragingly, the instructional technology discourse is digging deeper into how technology is perpetuating both systems of oppression and liberation; not just celebrating the newest, coolest gadgets and tech. By shifting the spotlight away from the tech tools themselves, ITFs can focus on pedagogy and its impact on society. There are several organizations around the world that are working to do this with intentionality in order to bring more women and people of color into STEM careers, including Code.org.

Over the last decade, Code.org has intentionally focused its attention on K-12 computer science access. This shift is centered around the opportunity gap that exists between women and BIPOC communities within computer science. Since 2013, the non-profit Code.org has been dedicated to "expanding access to computer science and increasing participation by young women and students from other underrepresented groups" (Code.org, 2021b). Its founder, Hadi Partovi, an immigrant from Iran, felt strongly about bringing computer science access to students, and over the years it has used its platform to connect K-12 students to the field. With the global movement of Computer Science Education Week, organizations like Code.org and the Computer Science Teacher Association (CSTA), created activities and awareness to the normed narrative of what a computer scientist looks like. Humans are creating the tech and, therefore, are constructing the societal perception of technology. Diverse representations in computer science will not automatically remove the racialization of software or colorblind pedagogy and curriculum if the system itself is centered around whiteness and white supremacy culture. Diverse representations, beginning in K-12, will offer a counternarrative to normalized discourse on who benefits from the tech and who will not (Tai et al., 2006; Ingen et al., 2018).

Future Work

Being able to identify a problem can help us remove barriers, change the narrative, and alter the trajectory of a certain course. Of course, naming a problem does not remove it completely, but it does allow for discourse that could lead to problem solving. If society continues to ignore the gender gap or the lack of BIPOC representation in technology, and STEM overall, then the perception of who those spaces are for will continue. Recognizing that tools are not inherently going to solve a problem or be equitable for everyone to access is

a step towards ensuring that there is intentionality in their use. Through intersectionality, educational leaders can uncover ways to use their positions as leaders and coaches in order to critically consider content and pedagogy. It is important to critique not only the content of the curriculum that is being taught, but also how it is being delivered (Chardin & Novak, 2021; Aguilar, 2020).

Pedagogical practice, or how an educator chooses to deliver their content and curriculum, can impact the student's learning and perception. Understanding how race and gender are centered in the classroom may lead to a shift in practice, which is often regarded as culturally responsive pedagogy or teaching. Being a culturally responsive educator who feels comfortable navigating inclusive pedagogical practices within instructional technology takes practice, support, and critical self-reflection. Through a Feminist and Critical Race Theory lens, these tenets remind researchers of the inequities that exist in daily lives and can inspire others to consider their coaching role deeply. May educators, coaches, and administrators continue to work towards creating, cultivating, and sustaining the learning spaces that are necessary for all K-5 students, where barriers are not created based on their identities as they pursue technology and STEM, but are allowed to flourish in these spaces because of who they are.

Reflective Bridge #1: Connecting from Our Problem Statement to the Literature

Review

Lessons Learned from Chapter Two

Chapter two allowed us to explore how technology is a tool for leveraging best practices in order to teach all students, but we found that instructional technology is not the "silver bullet" to solve our inequities that exist within learning spaces. This chapter allowed us to unpack the multifaceted layers that are required in order to understand how disparities exist between dominant and marginalized students. Acknowledging disparities but defining ways that pedagogy and technology can work together towards equitable outcomes, was supported by the problem statement.

As we considered how we ended up as Instructional Technology Facilitators (ITF) in our respective districts, we both think back to the excitement that technology brought to our classrooms. Instructional technology has shown us, as both educators and coaches, how empowering technology integration can be. There is no denying that technology brings the 'wow' hook into the classroom, but it can also continue to leave certain students behind if we are not considerate and deliberate in its use. Chapter two allowed us to set the stage for how technology can be used as both a tool to continue to create disparities for historically underrepresented students in education or empower them from those structures.

As we consider schooling as an inequitable space, then instructional technology can continue to feed into this structure by only being accessible to certain students. This means

that students of color, students whose primary language is not English, students who are not cisgender males, low-income students, or students who do not qualify for gifted services will continue to be limited from accessing or exploring instructional technology tools or consider future career pathways in STEM. During our dissertation process, we found ourselves sharing anecdotal coaching interactions, where we noticed certain students not having access to a tool as the rest of the class because of the assumptions or challenges that it presented for the teacher. In one instance, one teacher did not initially provide a student with a device because the teacher had assumed that the student, who is currently houseless, would be unable to navigate the device. In this case, the teacher assumed that houseless meant skill-less and proceeded to tether that assumption to the student's abilities. Another student was not able to participate in the class recording of their social studies project because they did not have the English language skills to complete the required worksheet independently and memorize a speech in English. Rather than seek out support from the ELL (English Language Learner) teacher or provide an adapted worksheet to note information about a historical figure of their choice, the teacher did not provide any differentiation or center the student's assets by recording in another language. The student attempted to mimic what other students at their table were completing but was very visibly left out of the learning process, and, therefore, isolated from the final product. Both students were male students of color and were being restricted from accessing the very tools that could be used to leverage their strengths and deepen their understanding of content. These students should not have been defined by their assumed deficits solely because they had different needs in approaching the lesson.

These are not rare occurrences that we have witnessed in our coaching role over the years. For these particular students, these happened to be interactions we witnessed. How many other times in their day or year are they being left behind, limited, or dismissed because of a teacher's implicit or explicit bias? As coaches, rather than ignore these dismissive actions out of frustration or accepting them as the way things are these are now instances that we can name, reframe, and coach teachers along as we consider the theoretical frameworks and pedagogical practices that center our work. These were challenging interactions that address race or gender bias as we coached teachers through an asset-based lens in order to thoughtfully integrate instructional technology.

Though this may seem like a sweeping generalization, if we apply both a Feminist and Critical Race Theory lens to our problem statement, it is easy to connect the dots. Not only did the understanding of both Feminist and Critical Race Theory provide us with a framework of naming the problem, but it also enabled us to consider what research already existed around the disparities we noticed.

Looking Ahead to Chapter 3: Literature Review

We selected *Educational Technology & Society (ET&S)* to submit our literature review because this journal focuses on research-based applications to guide educational pedagogy and practice. *ET&S* encourages submissions that not only identify areas for growth in educational technology, but also addresses changes that can be made to improve learning for students. Our research questions set the stage for areas in which need to be improved in educational technology along with our literature review to identify the way changes could be made.

Through this literature review, we set the stage for exploring inequitable representation in STEM education as well as defining the role of the Instructional Technology Facilitator in North Carolina. Since we are both ITFs in North Carolina, we utilized the North Carolina Digital Learning Standards for Students as well as the North Carolina Digital Learning Competencies for Teachers as these standards guide district expectations on technology integration. These standards are provided by the North Carolina Department of Public Instruction and the Digital Learning Competencies for Teachers are a required component of licensure renewal. Though technology standards are also embedded in the NC Educator Effectiveness System, having a requirement of two Continuing Education Units (CEUs) allowed for intentional professional development to be sought out by the educator or created by the district. Both the North Carolina Digital Learning Standards for Students and the North Carolina Digital Learning Competencies are 'neutral,' vaguely state the need for equitable access to instructional technology tools, and do not explicitly state culturally responsive teaching practices to eliminate barriers for students that have been historically marginalized.

We also defined and discussed research surrounding inequitable representation in STEM education regarding race and gender as these are disparities that are often noted in STEM. Using both a Feminist and Critical Race Theory lens as we approached this topic, we used existing research that demonstrates the need for equitable representation in STEM and what it means for K-12 classrooms, especially for our youngest learners. In order to address the needs of diverse learners, research demonstrates the use of Culturally Responsive Pedagogy and Universal Design for Learning (UDL) to center students in learning, especially with regards to instructional technology and STEM. These pedagogical practices give

educators a tangible way to shift their thinking while centering girls and students of color in their integration of technology and hands-on STEM experiences. This review leads to the importance of an ITF's role and their lens to culturally responsive teaching as crucial as they coach their educators.

Chapter Three: Literature Review on How Equitable Representation and Culturally Responsive Teaching Interact with the Role of an Instructional Technology Facilitator[2]

Education plays an integral part in preparing students to be productive members in their community through the process of achieving knowledge, skills, beliefs, and values. Educators are challenged with preparing students for an unknown job market. When it comes to learning, educators recognize that a background in mathematics, science, and technology can prepare students for their future careers, which became known as STEM education (Meadows, 2016). STEM stands for Science, Technology, Engineering and Mathematics and is an integrated curriculum approach. STEM education originated in the early 1990s and became popular in the early 2000s through legislative work on how to prepare students once they enter the workforce. Around 2014, STEM education curriculum became a popular term that resonated throughout the educational system. Part of the STEM curriculum is integrating technology into classroom instruction. Though STEM has become more prevalent in education, there are fewer women and students of color than white males that are enrolled as STEM majors and pursuing STEM careers (Fry et al., 2021).

Educational technology is ever evolving regarding devices, applications, software, and how technology skills are integrated into K-12 classrooms. Over the past two decades, institutions have been challenged with how to offer students 21st Century learning opportunities within the classroom environment while supporting educators with this shift.

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[2] This chapter will be sent to the journal, *Educational Technology & Society (ET&S)*

Twenty-First Century Skills not only offer a framework for successful learning in the classroom, but also skills students can use in their future careers. These skills have become known as the four Cs: collaboration, communication, critical thinking, and creativity (Smart & Corn, 2017). Over the past six years, the North Carolina Department of Instruction partnered with the North Carolina State University Friday Institute for Educational Innovation to develop a detailed digital learning plan that will not only support teachers with integrating technology and 21st century learning skills into their curriculum but also create learning opportunities for students. The North Carolina Digital Learning Plan (NCDLP) included the North Carolina Digital Learning Standards for Students and the North Carolina Digital Learning Competencies for Teachers to guide the integration of technology in the class curriculum (Friday Institute for Educational Innovation, 2015). Originally, the NCDLP was designed to support teachers and students in the classroom for in person learning, however, because of recent changes in instructional delivery due to the COVID-19 pandemic, the NCDLP began to support learning in a new way.

With the rise of remote learning due to COVID-19 quarantines and school closings, students and educators are experiencing various changes in technology integration. Technology has transformed from a tool used in the classroom to a tool that is required to connect students and teachers. Over the past two years, educators, parents, and students have all grappled with how to navigate the world of educational technology. Preparing teachers to utilize technology applications and ensuring that all students can participate in remote learning has become a challenge for school districts and instructional technology coaches alike.

The co-authors of this article are Instructional Technology Facilitators and recognize the importance of reviewing the literature to find what has worked previously and where improvements still need to be made due to recent instructional changes. It is key for educators, leaders, and coaches to evaluate how instructional technology has been utilized, but also how it can also be leveraged in order to transform teaching. This literature review will describe which students have traditionally had access to educational technology, equitable representation in the classroom, how culturally responsive teaching can support student learning, and the role of the Instructional Technology Facilitator in our North Carolina schools and how they can support students and teachers in an inclusive and equitable way for all.

Equitable Representation in STEM

In the authors' work as Instructional Technology Facilitators, they have found that the theme of *representation* continues to surface. They find themselves wanting to use their leadership roles in order to elevate underrepresented voices using technology. Recognizing the inequities in opportunities that exist for girls and BIPOC students in technology and STEM education leads to the following problem statement: **Technology is not being utilized effectively in K-12 classrooms to actively facilitate equitable representation in instructional technology opportunities and STEM roles.** For the purpose of this writing, the authors have named "instructional technology opportunities and STEM roles" as access to STEM skills and technology tools in K-12 classrooms as well as how these opportunities correlate with STEM higher education and career pathways.

Addressing the Problem

As scholars and women in the technology field, the co-authors are all too familiar with the educational gap that exists for historically marginalized students and educators (Ladson-Billings, 2013). There are far fewer women and Black, Indigenous, and People of Color (BIPOC) educators in STEM and computer science education as well as in the general technology field. As white and Latina women in educational technology coaching roles, the authors see these statistics and feel that both their Feminist and Critical Race lenses drive their daily work. From whom is expected to be successful in computer science to how access to tech tools continue to drive the digital divide, as coaches, they want to facilitate and support the integration of educational technology with intentionality. Instructional coaches and teachers are often in the driver's seat when it comes to creating and disseminating the use of technology in the classroom. Smart & Corn (2017) found, "as many districts and schools across the country move closer to fully transitioning to digital-age learning, digital inequity among K-12 students have become a more salient concern" (p. 3). Teachers, consciously or unconsciously, may give certain students access to STEM and technology tools, perpetuating the cycle of who they think will be successful with or are worthy of using these tools. Sengupta-Irving & Vossoughi (2019) used their small study in which two girls of color experienced STEM learning to uncover the continued sexism and stereotyping still present in the classroom today. They concluded, "our work makes visible how the sexism and racism that buoy white male privilege permeate in curricular materials, expectations of performance, and pedagogy" (p. 496). This causes a societally-normed expectation that males are the most successful in STEM and technology. To this end, technology is not being utilized effectively in K-12 classrooms to actively facilitate equitable representation in STEM opportunities and

roles. In order to demonstrate how technology is not being used effectively to elevate all students, the following sections will explore STEM representation and prevalent stereotypes that continue to be perpetuated.

Gender Bias

Gender bias is a tendency to prefer one gender over another. This bias can be unconscious and implicit in nature as well as derived from gender attitudes and stereotypes for one gender over the other. As students enter the hallways and classrooms throughout educational systems, these gender biases are cultivated by each student's environmental and societal influence (Moss-Racusin et al., 2018).

Mau et al. (2020) studied gender differences in STEM learning experiences, parental involvement, and self-efficacy to predict STEM career aspirations of different sociocultural groups. The participants consisted of public and private high school students from Taiwan and the United States. This research "indicated that boys and girls develop gendered perceptions of disciplines early in their education and these perceptions may impact gender differences in career interests and choices, steering them toward careers with less discrimination against their gender" (p. 33). Gender bias has played and continues to be a major role in students' decisions in their career or educational pathway. Even when students consider the toys they will play with or the books they will read, the students' choice will often refer to the role that gender bias plays in their reasoning. These products often advertise for a specific gender's perceived interest and continue to perpetuate a certain gender liking them. Gender opinion is not only in the marketing of the products, but also in the choice of who plays with the product as well. Persuasion of certain friends liking a new toy could persuade or prevent a student from it. Mau et al. (2020) found that both became factors in the

classroom. Students from an early age were influenced by their peers' gender perceptions as well as what they found to be a social acceptance for their gender. This gender perception has affected career pathways and choices, which leads to a lack of females pursuing STEM careers and fields of study as an outcome. It is important to understand how these gender biases live within educational systems in order to disrupt them.

It is hard to pinpoint where gender bias originated, but by looking back at women's history, one can understand how it has contributed to the ongoing issue. Bailey & Graves (2016) provide an overview of broad patterns and key developments in gender and education scholarship published in the Review of Research in Education for the American Educational Research Association (AERA). The centennial volume of the Review of Research took a retrospective approach on a diverse range of education research topics spanning the last 100 years. Each chapter utilized historical trends as a foundation and the authors also looked ahead to the most challenging issues and promising directions for the next century. They argued in their chapter that gender remains a central force in organizing social relations and educational processes in their research review on gender and education. They also found that historical exclusions from schooling along with male-dominated teaching and leadership, created a sense of inferiority in women and girls. This perception grew to become a socially-accepted feeling that is still felt within the walls of classrooms. Finding ways to counter this narrative requires attention to what and how students interact inside the classroom. Classroom setup, curriculum decisions, and teacher gender all play a role in how students perceive themselves as learners and how they understand themselves in society.

Equitable representation in certain subjects, such as mathematics and science, could alter a student's perception of how successful they think they are. Sansone (2018) found,

"there is growing evidence that gender differences in math and science are not caused by genetic factors" but are socially constructed (p. 27). Their study investigated the relationship between high school students' beliefs about women's abilities in math and science and their teacher gender, beliefs, and classroom behaviors. The study provided an in-depth examination of whether gender bias existed in the educational system and, if so, what was its catalyst.

The participants of the study were 21,440 students in ninth grade from approximately 940 schools (both public and private) across the United States, and the results of the study stated, "teacher gender was indeed pivotal" in reference to how female students perceived their own math ability (p. 129). Overall, female students were found to have lower confidence in their math and science abilities. The perception the female students had about their math and science scores were not a reality. In contrast, they were scoring on average higher in both science and math than the male students. Sansone took a further look into this phenomenon of how female students perceived themselves in both math and science and whether the gender of the instructor could break this perception. When confronted with the findings, female students did recognize that when female teachers were instructing these high school courses, they did not feel inferior. However, they still felt that the overall perception was that female students could not be as successful in math and science as the male students.

The conclusion that can be made from Sansone's study is that a teacher's gender can be strongly related to a student's beliefs. However, to change the female students' perceptions of their math and science ability goes further than having a female instructor. Sansone found, "female students were less likely to think that men were better than women in math or science when their teachers listened and valued ideas from their students" (p.

140). The gender of the teacher made a difference; however, the catalyst for this perception came from the actions and beliefs of the teacher. Sansone's study exposed a need for gender bias professional development and training for classroom teachers in K-12 educational systems. How teachers deliver their instruction or make decisions about their classroom, may reinforce their social and environmental perception of how students should act as well as what they will be successful in going forward. Currently, there is little training and research in the area of teacher gender perceptions and bias. Evaluating curriculum, along with instructional methods, could break this barrier for female students to feel as if they belong in STEM fields.

Influence of Prevalent Stereotypes

Stereotypes are a social, overgeneralized belief about a particular group of people. By stereotyping, it is implied that a person has a limited range of characteristics and abilities as their identified group. For example, girls are often stereotyped into playing with dolls while boys are thought to play with trucks. Boys may be pushed into liking the colors green and blue, while girls are thought to prefer pink and purple. These are all examples of how girls and boys can be stereotyped to their gender. When these gender stereotype influences enter the classroom environment, students begin to not only have this perception about themselves, but also begin to make assumptions and decisions based on these perceptions. Saucerman & Vasquez (2014) reviewed psychological barriers of female perception in STEM throughout their growth from childhood to adults. In early childhood, "young children perceive messages about social roles, their own competence, and possibilities for their future, both from overt instruction and from subtle, even unconscious influences" (p. 47). These stereotypes can be harmful to students that are exploring their gender identity and may find they do not fit into

the "right group." Breaking these gender stereotypes in educational institutions can be significant in female representation in STEM fields, but also in gender nonconforming and transgender representation.

Steinke et al. (2021) conducted a field study to identify the benefit for same-sex STEM role models to promote adolescents' identification within their educational learning and career choices. The participants were 291 sixth and seventh grade students from a public school in a suburban area in the Midwest of the U.S. Each student in the study was asked to rate the experience of their interactions with their role model. They also identified characteristics which were likely to promote participation for adolescents in STEM fields of study. There were four categories of role models represented; famous, established professionals, fictitious, and early career/aspiring. Four of the middle school science teachers completed an online, asynchronous STEM SMART (Strategies, Methods, and Activities for Re-envisioning Teaching) professional development, which provided the interventions that would be used during the 10-week teaching period. The STEM SMART professional development and classroom interventions were specifically designed for this study to promote STEM stereotype change and build STEM identity for middle school students.

During the 10-week classroom intervention, each teacher would utilize the Scientist Spotlight videos which included diverse STEM role models. The STEM SMART module topics included: broadening participation in STEM, student perceptions of scientists, media images of scientists, STEM stereotype threat, and STEM identity. After participating in the classroom interventions and viewing each of the Scientist Spotlight videos, all students completed an online survey to assess their perceptions of the STEM media role models in the videos. The student participants noted in the online survey that one or more of the STEM

professionals challenged the traditional stereotypes and perception they had of STEM. The

female students noted they could now picture themselves in the STEM field, which was

assisting in breaking down stereotypical thinking and perceptions. Steinke et al. (2021)

found, "gender stereotyping of STEM professionals is more prevalent among adolescents

who are more likely than younger children to view scientists as male" (p. 2). This emerging

belief begins around a student's 5th grade year. From this research, it is evident that same-sex

STEM role models can have a positive impact in how girls perceived themselves in the

classroom regardless of social gender stereotyping.

Another area where gender stereotyping in educational systems occurs is when

students begin to create their educational course of study pathway. Beginning in middle

school, students select courses to prepare for their future occupation and/or continuing

educational endeavor. It is important to understand how these decisions are made and what

affects their course selections. Dekelaita-Mullet et al. (2021) noted in their study:

> Because mechanical and technical skills are masculinized, girls may be
>
> vulnerable to stereotype threat; such stereotypes potentially harm girl's STEM
>
> self-efficacy and may discourage their interest in STEM. Acquiring those
>
> skills can empower girls with a sense of confidence they might otherwise lack
>
> in lab options. (p. 94)

Considering how courses are offered and presented can encourage or discourage female

students to select STEM courses. Dekelaita-Mullet et al. (2021) along with Steinke et al.

(2021) conclude that the way girls are characterized in the educational setting has a direct

impact on their educational and career decisions in STEM fields. Offering students same-sex

role models and including female students in classes with technical and mechanical skills can influence their participation in STEM fields of study and careers.

Response to Representative Role Models

Role models can serve as examples to influence other people and their perceived personal qualities, behaviors, or achievements can inspire others. In Sansone's (2018) study, he found that role models could play a beneficial role in increasing a girl's interest in STEM fields of study and retention. When girls were able to see someone like them of the same gender, they could visualize themselves in that role as well. Sansone (2018) found that role models could be a panacea in addressing the gender gap in STEM education. However, attention to role model selections is also important.

In a recent study, Cimpain et al.'s (2020) work compiled data from the U.S. Department of Education's High School Longitudinal Study of 2009. The dataset contained 5,960 students who were tracked for seven years. During this seven-year period, the students were ninth graders beginning high school until the first few years of college, which is when students in American universities traditionally declare their major of study. The purpose of the study was to understand the gender gap in STEM course selection. The researchers paid close attention to why students were selecting their course and the response behind their selection. They found STEM role models were beneficial for female students in feeling comfortable selecting and participating in STEM courses. Cimpian et al. cautioned that offering high achieving role models could have adverse effects by making STEM an unattainable goal. Sansone (2018) investigated how female students viewed themselves in STEM educational courses. He found, "on average, having a female teacher reduced the probability of believing that men were better than women in math/science by almost six

percent points for female students" (p. 134). Having a female teacher in math and science begins to change the perceptions female students have of themselves. Similarly to Sansone, Steinke et al. (2021) study showed, "that female scientist role models had positive effects on male and female fifth and sixth graders' ideas about scientists, science participation, and self-concept towards scientists" (p. 5). This demonstrates that female representation in scientists is not only for the benefit of the female students, but also for male students as they shift their paradigm by seeing another female leading math or science. Changing this gender perception is a start to closing the gender gap in STEM education.

Sengupta-Irving & Vossoughi (2019) assembled ethnographic data on how girls make meaning of their everyday experiences in two settings: a mathematics class in a suburban high school and a STEM based after-school program in a working-class urban community. The sample consisted of only two girls of color who were experiencing two separate STEM learning environments. Although the small sample size makes it difficult to draw generalizable conclusions, both girls felt a sense of not belonging, which was found to be in the lack of confidence the girls had in themselves in the areas of STEM study as well as the absence of female role models. The researchers agreed that, "the experience of seeing oneself reflected in these intellectual and professional domains is undoubtedly powerful" (p. 496). They found the two girls in their study felt a sense of empowerment when females were leaders in STEM courses and careers. Both girls lacked the experience of being able to see themselves reflected in the STEM intellectual and professional domains, which to them was profoundly powerful. This study mirrors the previous research work included and offers more information on how students personally perceive themselves in an in-depth way regarding STEM roles and opportunities.

The research points out that role models are beneficial for all genders. Providing a visual representation of females in the field of STEM can showcase how there is value in pursuing a STEM educational pathway. Careful consideration in role models also influence how girls perceive themselves of being capable of entering the STEM field. Balanced representation of role models can support all students that they belong in STEM. Just as important as it is for girls to feel included, educators also must consider other marginalized student groups in the classroom and their experiences in STEM and utilizing technology. Reviewing pedagogy introduced and used within educational environments can assist with understanding how to provide instruction that is inclusive of all students.

Why Educators Need Culturally Responsive Teaching

Schooling and access to education has not always been for everyone. Educational systems in the United States were founded with wealthy white males in mind, but they did not include poor children, white females, and students of color (Leonardo, 2009). Historical context is important when considering pedagogy, especially when it intentionally excluded certain students for many years. Research in education has evolved over time to consider all students and their needs. Too often, barriers have limited certain students from fully being a part of the classroom. Immigrants and indigenous students were scolded and reprimanded for speaking in their native tongue while entire Native American communities were stripped of their culture in order to assimilate their children into what an educated American looks like (Brayboy, 2014; Valenzuela et al., 1999). In 1864, the United States Congress passed a law making it illegal to teach Native American children their native language, and children as young as four were taken from their parents to off-reservation boarding schools in order to "kill the Indian to save the man" (Race Forward, 2021). These sentiments and rules are not

limited to history from many years ago, as states like California attempted to prohibit public education from undocumented students as well as remove bilingual education in the late 1990s (Race Forward, 2021). Race, gender, and culture have long played into who gets access to education or is seen as 'educated.' Since education was a privilege for certain individuals to have access to, it also means that certain pedagogical views continued to flourish in teacher training programs, and professional development in districts across the country, thus perpetuating a cycle of disservice to historically marginalized students and teachers.

Though there may not currently be a law explicitly limiting native languages and culture, implicit practices that center whiteness in the classroom also have a detrimental effect on students. As Zamudio et al. (2011) reminds us, "society's understandings of race, the meaning it has placed on blackness, redness, brownness, and whiteness is not undone with the stroke of a pen that brought us the Civil Rights Act of 1964," and, therefore, societal discernment of race continues to be influenced by this historical context (p. 23). A change in a law may create a change over time, but individual educators and their implicit and explicit biases will still influence their daily pedagogical practices, including colorblind understandings of their students.

The work of Angela Valenzuela, who specifically researches the experience of Mexican migrant students, Mexican American students, and their culture in the classroom, discusses how this impacts those students. Valenzuela et al. (1999) describes schooling as the forced assimilation of Mexican migrant and Mexican American students simply by participating in public education and removing their connection to their culture and language. Valenzuela describes this process as 'subtractive schooling' where Latinx students do not see

their culture and values reflected back to them, and therefore they find no value in the education system. The absence of 'caring,' which is held to a high regard in Mexican communities, is reflected in the Latinx students' perception of who American schools are for and who they benefit. Education holds power, as stated by Indigenous educational anthropologist Brayboy (2014):

> From an Indigenous perspective, education serves multiple purposes. Education is not simply the passing on or transfer of knowledge from one generation to the next, although this is important. Education in its many forms is imbued with power: power to control young peoples' bodies, epistemic engagement, curriculum and teaching; power to best determine how education and schooling are utilized and to what end; power to control what kinds of knowledge is shared—or not— when, and where. (p. 396)

Given that the American educational system was intentionally created with the intent of only educating limited populations and over time has had a history of marginalization, it should come as no surprise that educators today continue to view the cultures, languages, and assets of students who identify as Black, Indigenous, and People of Color (BIPOC) as deficits in the classroom (Yosso, 2005). With the achievement gap being used as a modern litmus test to rate academic worthiness and detect deficits, educators continue to ask BIPOC students to conform to white culture and expectations.

To be a culturally competent educator is to understand that students have varying cultures, expectations, traditions, languages, and norms that may be different from the classroom teacher (Hammond, 2015). The question for educators becomes: how do educators take an individual's understandings of race, culture, language, dis/ability, and gender

representation to inform teaching practices in order to reach all students? These intersections

of identity are all important facets to consider when creating a unit or lesson. Geneva Gay

(2018) shares that, "[...] examples of culturally responsive activities and teaching practices

that validate students by utilizing cultural knowledge, prior experiences, frames of reference,

and performance styles of ethnically diverse students to make learning encounters more

relevant to and effective for them" (p. 29). This statement not only echoes the sentiments of

what other BIPOC researchers and educators have stated, but other authors also offer

defining characteristics of culturally responsive teaching. Gay (2018) describes culturally

responsive teaching as validating, comprehensive, multi-dimensional, empowering,

transformative, and emancipatory. Each of these facets supports students, but most

importantly, they move pedagogical practice from trying to make a lesson fit the students to

making the students a part of the lessons.

Characteristics of Culturally Responsive Teaching

Validating. Content and curriculum seek to utilize students' assets and cultural lenses

in order to make it relevant to the students themselves. Prioritizing relevance leverages a

student's prior knowledge and cultural references to make learning engaging (Woodley et al.,

2017). As stated by Gay (2018), "[Culturally Responsive Teaching] teaches to and through

the strengths of these students" (p. 29). Hammond (2015) reiterates this by stating that the

"individualistic dominant culture" often highlights students for what they do rather than

affirming a student in relation to their racial, cultural, gender, or linguistic identity (p. 85).

Affirming students with a commitment to lifting up their identities brings in community

strengths and the beauty of diversity, not solely their academic or behavioral responses in the

classroom space (Hammond, 2015).

Comprehensive. The educator helps maintain the students' cultural, racial, ethnic

identity, and sense of community to their identity group(s) (Woodley et al., 2017). It is

important to note that this allows for the educator to see the child fully rather than by one

identity. It also centers the student as part of the class community rather than having them

conform to the class. This is restated by Gay (2018), "They [Students] are expected to

internalize the value that learning is a communal, reciprocal, interdependent affair, and

manifest it habitually in their expressive behaviors" (p. 38).

Multi-dimensional. Culturally Responsive Teaching is more than just relevant

content, but moves beyond singular lessons. It is a part of the classroom culture, management

systems, inter/intrapersonal relationships, and unspoken rules (Hammond, 2015; Woodley et

al., 2017). It also means that various subjects come together to help a learner understand a

concept. For example, when teaching poetry, concepts may be taught in English Language

Arts, but also in social studies, music, and art class in order to help students make

connections across all different disciplines as students construct new knowledge (Gay, 2018).

Empowering. A culturally responsive classroom means that students feel confident

and empowered in their learning (Ladson-Billings, 2009; Hammond, 2015). They are given

space, time, and a safe learning environment to be independent learners that are invested in

their learning (Woodley et al., 2017). Providing students with the scaffolding needed to

manage their learning target through data notebooks or inquiry journals allows the student to

be in charge and invested in their learning (CAST, 2018). The goal is to shift from having the

teacher as the one managing learning goals to having individual students aware of and

directing their own learning goals. This is an intentional and explicit practice that gives

students the skills and strategies to manage their learning goals in order to transition from dependent to independent learners (Hammond, 2015; Chardin & Novak, 2021).

Transformative. This is a key definition that specifically refers to respecting the cultures of individual students. Whereas the normed expectation of a safe and successful classroom means it is a monocultural classroom, a transformative classroom sees the various cultures of a classroom as a strength that can be capitalized in order to enhance learning (Woodley et al., 2017; Milner et al., 2019). In regard to the culturally responsive classroom, Gay (2018) says, "It recognizes the existing strengths and accomplishments of these [BIPOC] students and then enhances them further in the instructional process" (p. 34).

Emancipatory. Intentionally breaking away from what is seen as canon literature or knowledge by having various representations of diverse peoples brings validation and pride along with information that is psychologically and intellectually liberating (Hammond, 2015; Woodley et al., 2017). An emancipatory classroom gives students space to be critical of learning content, but it also gives students the skills to synthesize social issues and histories, including their own experiences (Gay, 2018). As described by Gay, "These learning engagements encourage and enable students to find their own voices, to contextualize issues in multiple cultural perspectives, to engage in more ways of knowing and thinking, and to become more active participants in shaping their own learning" (p. 35).

Each of these pieces of CRT help guide educators as they rethink and reshape their perspective on their classroom environments, content, curriculum, and teaching moves. How educators choose to create and implement content and curriculum can either begin with equity or inequity by its design, depending on who the work is centered around. It is also important to note that these practices can look vastly different when considering the

developmental needs of a kindergartener versus a sixth grader. The goal is to model and support students in order to develop independent learners while centering student strengths throughout the process.

Neuroscience and the Classroom

Author and educator, Zaretta Hammond invites educators to consider how Culturally Responsive Teaching connects with neuroscience in order to recognize how current practices are not meeting the needs of most underserved students. Her work focuses on how brains function and gives educators an understanding of how their practice can be ineffective, especially for students of color. Hammond (2015) states that Culturally Responsive Teaching is acknowledging students' unique ways of learning, synthesizing information, and responding "with teaching moves that use cultural knowledge as a scaffold to connect what the student knows to new concepts and content in order to promote effective information processing" (p. 15). Educators must have a better understanding that students come from both individualistic and collectivist cultures. They must also be aware of how a brain responds to an unsafe learning environment, which is a key piece in moving students from dependent to independent learners.

In *Culturally Responsive Teaching and the Brain*, Hammond describes the first quadrant of the "Ready for Rigor Framework" as Awareness, where teachers must work on developing their own "sociopolitical position" that guides their work as well as the social emotional response they have when teaching diverse populations (2015, p. 18). By utilizing the 'Awareness' quadrant of the "Ready for Rigor Framework," teachers explicitly acknowledge their own racial identity, but also of those in their classrooms in order to center race, culture, and uncover deficit-based thinking that is linked to specific students. This

framework also acknowledges the need for explicit and intentional teaching moves so that student cognitive load is through authentic and meaningful learning experiences. The author continues to discuss the educators' understanding of the teacher-student-caregiver relationship as well as their social-emotional well-being in order to have a calm mind to access learning. It is important to note that although this "Ready for Rigor Framework" gives teachers a great start to developing culturally responsive learning environments, it is not something attainable in a seasonal book club or a workshop. Hammond reminds educators to seek intentional learning and not to be stagnant in their practice. It means that educators must unpack systems of dominant culture and white supremacy in order to ensure that students who have systematically been marginalized are seen, heard, and valued. By understanding the neuroscience behind how students learn and how an individual's culture influences their cognitive processing, educators and educational leaders can attempt to create inclusive learning environments.

Culturally Responsive Universal Design for Learning

Initially grounded in supporting neurodiverse students, Universal Design for Learning (UDL) is a framework of research-based practices that guide teachers through pedagogical decision making (Kieran & Anderson, 2019). These UDL practices were created by researchers in the mid-1990s to bring computer technology to students with disabilities (Doran, 2015). Accessibility through instructional technology became the bridge between the content and supporting various learning needs. Today, UDL gives teachers the opportunity to reflect on their pedagogy to ensure that all learners become "expert learners," and gives students strategies on how to be resourceful and goal-oriented (CAST, 2018). Doran (2015)

asserts that, "UDL provides a roadmap for educators to think through the process of identifying barriers to learning and working to remove them" (p. 4).

UDL guides educators through research-based pedagogy that considers all learning needs, and to steer away from one lesson or unit for all students. Described by CAST (2018), UDL includes: 1) Provide multiple means of engagement, 2) Provide multiple means of action and expression, and 3) Provide multiple means of representation. These three components allow for educators to pinpoint their desired need while connecting teachers with an understanding on how students learn. Oftentimes, UDL is connected to special education or accessibility accommodations such as closed captions, voice-to-text transcription, or screen magnification, but it is important to note that cognitive barriers can be more than dis/ability. Cognitive barriers may also include how a student feels centered within the curriculum or learning space. Brown et al. (2021) states, "As the number of students with different cultural background [*sic*] increases in schools, technology has the potential to provide cultural representations of phenomena that matter in their lives" (p. 10). Brown reminds educators how culturally responsive use of technology can bring change to students, including those that have been historically underserved. Understanding how pedagogy directly impacts students, whether intentional or not, is key for those in instructional support roles, such as the Instructional Technology Facilitator.

Role of the Instructional Technology Facilitator

The educational system is organized to not only support students in the classroom, but also support educators with pedagogical methods, curriculum, on-going training and professional development, and other support services to ensure students in their classrooms are receiving an equitable learning experience (Sugar & Kester, 2007; Smart & Corn, 2016).

With the prevalent use of technology in educational settings, teachers rely on their school system for device support, network connectivity, and instructional technology pedagogy. Each school system and district organize their technology department differently however, the main purpose is to provide teachers and students with the necessary equipment and teaching tools to provide 21st century learning daily.

In 2015, the North Carolina State Friday Institute for Educational Innovation, along with educators, policy makers, and stakeholders from around the state of North Carolina, developed the North Carolina Digital Learning Plan (NCDLP) (Friday Institute for Educational Innovation, 2015). The NCDLP was developed to provide the North Carolina State Board of Education with an overview of how digital learning was supported across the state and to provide insights into how to improve technology support within the state and specific regions.

The first part of the plan was to analyze the current and previous work in the area of digital teaching and learning deployed throughout the state. Programs such as LEARN NC and the IMPACT Model were reviewed based on their implementation and successful support in each school system. LEARN NC was a partnership of North Carolina public schools, North Carolina community colleges, the University of North Carolina system, and private industries working together to, "deliver professional development opportunities and learning resources that increase student achievement, enhance teacher proficiencies and foster community participation in the educational process (Friday Institute for Educational Innovation, 2015). The IMPACT grant stated:

school library media and technology programs should focus on student achievement and involve the entire staff in collaboratively planning

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instructional programs that are authentic and engaging, enriched by high-

quality resources, current technologies, and effective models of integration.

(Friday Institute for Educational Innovation, 2015, p.19)

While these programs were successful in creating professional development and training for digital teaching and learning, due to funding limitations, they were no longer able to continue. From the work of both major implementation programs, the role of the Instructional Technology Facilitator was created and found to be important to the success of integrating technology into classroom instruction in K-12. Instructional Technology Facilitators (ITFs) are tasked to:

have expertise in digital learning and play essential roles in supporting teachers

in their transition to digital learning. They provide model teaching, coaching,

support for planning lessons and selecting digital resources, facilitations of

professional learning groups, hands-on training, student activities and other

support. (Friday Institute for Educational Innovation, 2015, p.34)

The ITF role encompasses both providing and sustaining classroom technology with access and pedagogical best practice. ITFs are expected to keep up-to-date on new technologies, and how they can be utilized, and integrated into classroom instruction. Data collected in the NCDLP confirmed the integral role ITFs play in digital learning within the school district and classrooms. One of the challenges noted from the task force was, "only 16.5% of schools have a full-time ITF, and only 13.9% have a part-time ITF. Superintendents have identified current licensure requirements for ITFs as a barrier to filling this role in their schools" (Friday Institute for Educational Innovation, 2015, p. 81). Since the ITF role was found to play an integral role in digital learning and development, having only approximately

30% of schools with an ITF position causes some concern about the lack of technology

support for classrooms. In 2014, a study by Stanhope & Corn was conducted by North

Carolina State University on a one-to-one initiative in four NC high schools. At the

conclusion of this work, Stanhope & Corn noted, "access to technology itself will not

transform teaching and learning. To obtain desired results, teachers need to harness

supportive attitudes toward, feel comfortable using, and actually incorporate the technology;

further, an instructional culture of technology use must be established" (p. 270). Stanhope &

Corn found the culture of technology integration to be crucial was the ITF role within the

schools. They found the ITF role not only provided guidance, training, and technology

resources for the classroom, but also cultivates a space for a shared vision in how technology

can be utilized in the classroom environment. The ITF can support classroom teachers with a

way to create a manageable and supportive integration of technology (Stanhope & Corn,

2014).

In a recent study, Ellis et al. (2021) explored the perceptions of North Carolina school

administrators on how they felt digital learning was supported in their school. In 2016, the

North Carolina State Board of Education approved the integration of the North Carolina

Digital Learning Competencies for Classroom Teachers (NCDLCs) (Appendix A). These

competencies were informed by the International Society for Technology in Education

(ISTE) Standards. The purpose of the NCDLCs was to blend content knowledge, pedagogical

strategies, and technology resources. Ellis et al. (2021) found,

Technology has become a conventional tool for students to learn as well as

becoming a necessity to develop digital age ready students as they transition

from K-12 school settings to successful digital citizens in higher education

institutions, military, and careers. (p.697)

This study consisted of 21 former and current Educational Leadership program students at a

doctoral-granting university. The purpose of the study was to gain insight into the perception

of NCDLCs and how these competencies impacted students in the classroom and the best

practices used by teachers. Data for the study were collected through a web-based

questionnaire distributed to current and former program students and semi-structured

interviews. At the conclusion of their work, Ellis et al. (2021) found that ITF support played

a critical role in supporting students, teachers, and administrators in meeting the criteria of

the NCDLCs. However, due to the small number of staff members in the ITF role, Ellis et al.

(2021) suggested a 12-credit hour graduate certificate for leaders to learn about technology

leadership to support North Carolina teachers on implementing technology into their

classrooms. However, the study did caution that the best resource is having ITFs in place for

ongoing training and implementation resources. The barrier remains in staffing and funding

for the ITF position in NC. Due to the key role that Instructional Technology Facilitators play

in supporting teachers and students with access as well as pedagogy, the ITFs perception of

who can be successful in STEM and technology has a major influence on classrooms

themselves. Culturally responsive instructional coaches can ensure that all students have

equitable and inclusive access in their classrooms.

Gaps in the Literature

After reviewing the literature on equity of digital learning, inclusion of all students in

STEM roles and opportunities, and the Instructional Technology Facilitator (ITF) role in

North Carolina, some gaps in the research field were revealed. The included literature lays the groundwork for further research work in the areas of addressing the STEM gender gap earlier in education, creating culturally responsive pedagogical practices with intentionality, and a connection of how instructional technology can be grounded in culturally responsive instruction to support North Carolina students in STEM and 21st Century Learning opportunities.

First, addressing the gender gap in STEM, which begins in elementary school, is an area that has not been resolved. The array of research on the gender gap in STEM has been broad, however, the gender gap remains. Most of the studies focus on students in middle school, high school, or college and leaving little research on students in elementary school. As several research studies presented in this literature review have pointed out, student gender perceptions form from a young age. Steinke et al. (2021) concluded, "few studies have examined the influence of diverse media STEM role models challenging adolescents' gender, racial, and ethnic stereotypes of STEM" (p. 2). Working with students before middle school to address gender stereotypes could benefit how female students perceive themselves and begin to work on closing the gender gap.

As stated in literature above, the importance of centering students and their assets is crucial to creating transformative learning spaces. So often, classroom teachers need guidance on what that really looks like in practice to make a paradigm shift. Moving from theory to practice is important in order to rethink teaching moves and create impact for all students. Most of the literature states compelling reasons on the importance of why educators should utilize culturally responsive Universal Design for Learning (UDL) practices, especially through the use of instructional technology, but do not present tangible evidence

and examples for teachers to reshape their practice. UDL is an approach to teaching

instruction, so all learners have an equitable opportunity to learn and succeed. Again, the

goal is not to provide a checklist, but instead to offer teaching practices that may support a

paradigm shift to culturally responsive learning spaces.

There are also great strategies in literature that discuss instructional technology tools,

but fail to mention CRT explicitly. Though protocols are valuable structures for students, in

The EduProtocol Field Guide by Hebern & Corippo (2018), the authors do not mention race

as it describes classroom "culture" and students are seen as generic. The assumed "culture"

in their text is colorblind and does not acknowledge the diverse assets and needs of the

classroom. The structure of a lesson or unit should be accessible and reflective of the students

rather than centered around the educator, and race, ethnicity, gender, and language should be

explicitly examined in this process. This colorblind approach was also noticeable in the

article by Westine et al. (2019) where there was an in depth look at UDL and accessibility for

equity focused instruction, but the article does not name race or the need to reflect on the

demographics of the teachers themselves.

The literature also does a great job of demonstrating the value of culturally responsive

teaching and transforming classrooms for historically marginalized students but fails to

discuss the resistance among current educators and leaders in districts across the country. As

a matter of fact, Aguilar (2020) states that coaches will encounter resistant teachers,

especially when addressing inequities and that "resistance is an expression of strong

emotions" (p. 175). Not every educator is ready to rethink and retool their classroom spaces

nor is every leader ready to decenter whiteness by offering space and time for educators to

process and critically reflect. For many, culturally responsive UDL is a huge shift that

requires courageous leadership that is willing to critically evaluate and deconstruct perceptions of what learning looks like. Perhaps it is the unspoken statement when researchers must mention how schooling has historically left BIPOC students behind, but acknowledging the disparities due to race, and other identities is necessary for educators to make note of how their pedagogy is perpetuating inequities. Along with more explicit connections between instructional technology and culturally responsive pedagogy, how STEM is represented and cultivated in K-5 will be beneficial in future research.

Looking Forward

STEM education is important to the growth of students in the classroom as well as the greater community. Providing technology-infused lessons that also ensure students are 21st century learners who can communicate, collaborate, be creative, and think critically can provide students with the skills to thrive in a world that is constantly changing and where learning never stops. Considering the current disparities that exist in STEM requires educators and leaders to be mindful that STEM should be inclusive of all genders and students of color.

Educational institutions continually work to provide students with rigorous curriculum and instruction to prepare students for their future careers. Understanding how students perceive themselves in their educational environment and how it can have an impact on their career decisions is an area to explore further. When specifically considering female representation in STEM education, the burden of agency can be addressed as an institution. Further work of institutions from elementary school to higher education in female students' perceptions, teacher gender bias, and the presence of gender stereotyping in the learning environment could unveil ways to begin to work on closing the STEM gender gap.

Student self-efficacy is the judgement that students make about their own capability to achieve a future task in their educational pathway. Addressing how to increase female students' self-efficacy in pursuing STEM would not only benefit the gender gap, but also create the opportunity for female influence in STEM. Sansone (2018) argued, "the underrepresentation of women/girls in STEM is problematic not only due to concerns of inclusion, but also because of the limitations this imposes on the growth of scientific knowledge itself" (p. 135). Without diverse gender representations in the STEM field, voices are unheard and ideas are unspoken. Further work in understanding how to promote self-efficacy in female students to pursue STEM is an important venture to explore.

Being a culturally responsive educator who feels comfortable navigating UDL practices within instructional technology takes practice, support, and critical self-reflection. Considering the reasoning presented in the literature, educators cannot afford not to be culturally responsive. Preservice teacher education programming as well as professional development support must be given to new teachers as well as veteran teachers. Just as instructional technology should not live only in computer labs; Culturally Responsive Teaching should not be limited to certain content or BIPOC educators. Chuang et al. (2020) echo that, "professional training and pedagogical modelling of technology use, especially in classrooms with culturally diverse students, is highly recommended" (p. 2443). They continue to state that the more exposure to technology-related experiences, the more likely educators are to modify their teaching practices to support their culturally diverse students (Chuang et al., 2020).

In 1995, when Ladson-Billings followed educators who were considered culturally responsive, she described them as passionate in their work with an interest in fluid and

equitable relationships with students and evaluated content with a critical lens. Twenty-five years later, the same can be said for culturally responsive educators in the field. Educators and leaders who are willing to have a critical lens on their pedagogy and schooling and commit to non-closure while unlearning deficit-based pedagogy can lead to transformative learning spaces. In other words, educators need to understand that they will not be able to make this shift immediately nor can they check "culturally responsive teaching" off of their 'to-do' list. As Valenzuela et al. (1999) poignantly states, "Without exception, it is the teacher there who makes the difference. Unconditional, authentic caring resides therein." (p. 274).

Reflective Bridge #2: Literature Review into Data Collection and Analysis

Lessons Learned from Chapter 3

Passion is defined as being a strong and barely controllable emotion. Passion can be the catalyst for many things we do in our daily lives, however, the focus of our passion for education lies within creating an equitable learning environment that incorporates STEM education, integrates technology, and provides students with 21st Century Learning Skills exploration. As we have grounded ourselves in both Critical Race Theory and Feminist Theory, we found that our driving passion for students was within our study and the results demonstrated how to make classrooms in our districts equitable learning environments.

After a deep dive into the literature on how to address the student learning gap often caused by the learning environment, we found that technology can be the place where students feel the field for them is being leveled. Our work to integrate technology as Instructional Technology Facilitators is to provide resources and guidance for teachers to utilize technology in their curriculum, however, we wanted to take it a step further and, not only enhance student learning, but also allow our students to feel as a part of their learning community in a way that also celebrates who they are.

Technology continually evolves and can enhance our lives. In education, technology can be utilized in the classroom by both teachers and students. It can open a world of learning and exploration to students, such as taking them on a virtual trip around the world, or by communicating with peers from diverse cultures. George Couros (2017) stated, "Technology

will never replace great teachers, but technology in the hands of great teachers can be transformational." We believe that technology in the hands of all teachers can transform their instructional practice and student learning. The challenge is how to integrate technology into the classroom effectively. Identifying teacher perceptions and barriers, while understanding how to create transformational classroom environments, will guide the direction of our work. We developed our problem statement and aligned our research questions to guide our study. We reviewed the research work already in the field that addressed our questions and found the gaps in which we based our work on.

Looking Forward to Chapters 4 and 5

The U.S. Department of Education's 2010 National Educational Technology plan notes "widespread agreement that teachers, by and large, are not well prepared to use technology in their practice" (p. 39). This statistic is now eleven years old; however, most educators still require professional development and guidance on how to utilize and integrate technology into their curriculum with the support of state, national, and international technology standards, such as the ISTE Standards for Educators (International Society for Technology in Education, 2022). Part of the 21st century learning push includes digital literacies as a component. Educators are seen as a role model or guide for students on how to work and collaborate in a digital world. Integrating technology requires more than knowing how to operate a computer or simply use a particular software program. Teachers may possess a high-level understanding of technology; however, they can still fail to integrate technology into their classroom curriculum. Cortez (2017) found that 86% of K-12 teachers use technology in the classroom daily, while 25% of those teachers admit they are intimidated by the students' knowledge and use of tech. Investigating how to bridge the

learning divide of teachers and technology usage will benefit not only the teacher's instructional practice, but it will also impact their students' learning as well. Our work considers amplifying students' voices and choice in their autonomy of learning in the classroom. Creating a classroom environment where both the student and teacher are learning together in a partnership provides an opportunity for students to feel included.

As ITFs, we have seen the positive effects of technology integration and have witnessed the anxiety it causes our fellow colleagues as well. Using our specialized lens of Critical Race Theory and Feminist Theory, along with focusing on integrating technology, we investigated how we can alleviate some of the anxiety technology integration can bring and offered the teachers in our districts an insight on how to create an equitable learning environment for historically marginalized students. This required us to carefully consider the intersectionality of the various identities of our teachers and students, including, but not limited to, gender and race. Chapters 4 and 5 delve into defining 'intersectionality' and how it connected to our coaching.

As we move from our literature review into our methodology articles, we are reminded that our work was driven by our three research questions:

1. What is the role of the instructional technology coach in supporting teachers as they use technology to facilitate equitable representation in STEM, both in opportunities and future career pathways?

2. How can an instructional technology coach support a teacher in evaluating their pedagogy through an asset-based lens?

3. In what ways can a meaningful learning partnership be cultivated between an instructional technology coach, teacher, and student by collaboratively developing a lesson that centers students' voice and choice?

We worked together to analyze our data as it relates to addressing each of these research questions. Our data collection included surveys, focus groups, coaching work plans with our co-teachers, and researcher field notes throughout the teaching experience with the teachers and students. Our research work began with a survey about the perception of the ITF role in each district. The survey was a voluntary way for administration, teachers, and school support staff to offer their understanding of the ITF role and how it was be utilized in their district. From this survey, participants were able to self-identify if they would like to take part in either a follow-up interview and/or a co-teaching opportunity. The follow-up interview provided more insight for the researchers on how the ITF role was utilized and defined in each district. Teachers who opted to participate in the co-teaching opportunity worked closely with each ITF in creating culturally responsive UDL lessons that integrated technology. Each co-teacher worked collaboratively with their ITF on a coaching work plan utilizing the UDL framework from professional development delivered by the ITF. Both researchers recorded field notes throughout the process that were only used by them to reflect on the progress of the coaching work. At the conclusion of each co-teaching session, the ITF in each district debriefed with all the teachers in a focus group and conducted a voluntary student focus groups to gain understanding of the effect the lesson had on learning in the classroom environment. The following table demonstrates how each research question was directly correlated to the method or instrument utilized during our Fall 2021 work (Table 1).

Table 1

Research Question	Instrument or Method
What is the role of the instructional technology coach in supporting teachers as they use technology to facilitate equitable representation in STEM, both in opportunities and future career pathways?	**Survey #1: Perception of ITF Role** *(22% response rate for District A and 19% response rate for District B)* **Follow-up interviews** *(7 participants total)*
How can an instructional technology coach support a teacher in evaluating their pedagogy through an asset based lens?	**Survey #2: Culturally Responsive UDL** *(Pre, 11 participants total; 6 participants in District A and 5 participants in District B)* **Coaching work plans** **Field notes** **Survey #3: Culturally Responsive UDL** *(Post)*
In what ways can a meaningful learning partnership be cultivated between an instructional technology coach, teacher, and student by collaboratively developing a lesson that centers students' voice and choice?	**Coaching work plans** **Student Focus Group** *(2 student groups per district with their respective ITF)* **Teaching Focus Group** *(1 teacher group per district with their respective ITF)*

As this research was tethered so closely to our full-time jobs, we wanted to ensure that we were addressing the needs of our study and being consistent between our two districts. As collaborative researchers, having clear and consistent expectations for data collection was key to our success and ability to address the aforementioned research questions.

After collecting all data, we viewed these survey responses, field notes, interview transcripts and focus group transcripts through our individual lens of Critical Race Theory and Feminist Theory. Our conclusions were based on the data that we collaboratively collected and shared with one another but rendered through our own theoretical framework. Finally, we both addressed the implications of our work and how it can continue to improve classroom instruction in both of our districts.

For Chapter 4, the journal, *Issues and Trends in Learning Technologies (ITLT)*, was selected. This journal seeks discourse around theory and pedagogy with a focus on innovative pedagogy and instructional design. Since Chapter 4 connected theory with pedagogy by centering race and ethnicity, this journal was deemed to be a good fit.

For Chapter 5, we selected *The Elementary STEM Journal* which accepts specific articles that address theory and practice related to student experiences in elementary STEM education. Due to the underrepresentation of females in STEM educational opportunities and our work solely with elementary teachers and students, we felt our article would offer practical applications on how to shift elementary STEM pedagogy to provide more opportunities for female students to participate in STEM learning.

As a reminder, readers will encounter repetitive definitions and familiar data sets, but will note the difference through our distinct Feminist and Critical Race Theory lens. Though our conclusions overlap due to the intersectional nature of our work, our focus on gender and racial identities take center stage.

Chapter Four: An Instructional Technology Facilitator's Role in Culturally Responsive Pedagogy Using a Critical Race Theory Lens[3]

> By pulling back the curtain and drawing attention to forms of coded inequity, not only do we become more aware of the social dimensions of technology but we can work together against the emergence of a digital caste system that relies on our naivety when it comes to the neutrality of technology. (Benjamin, 2019, p. 11)

Standardized testing has become the gauge of student achievement and success in districts across the country with a glaring achievement disparity between students of color as compared to white students. By focusing on the 'achievement gap,' educational leaders have centered the deficits of students of color as compared to their white peers. Rather than use standardized testing as their main guide and center a student's deficits, educational leaders and classroom teachers should evaluate their pedagogy and inequitable practices that contribute to the disparity in student achievement. As stated to Eakins in his podcast, "Leading with Equity," Gay states, "There is no such thing as universal good teaching because somebody determines what constitutes good teaching and those 'somebodies' are cultural beings [...] [and] their notions about what good teaching is, have been contaminated by their own cultural filters" (2022). Critical self-reflection allows for teachers to ask probing questions on how their content and pedagogy are being centered (Milner et al., 2019). Teachers who do not "see color" or who refer to their classroom culture as a monoculture are disregarding the strengths and assets that their students of color bring to their classroom (Hammond, 2015).

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[3] This chapter will be sent to the journal, *Issues and Trends in Learning Technologies (ITLT)*

Implicit and explicit biases, especially in high stress environments like a classroom, can hinder or limit certain students from being successful or fully seen by their teacher. Instructional technology, in both access to and application of, can be utilized to further perpetuate harmful disparities, but also as a tool of empowerment for historically marginalized students. Though instructional technology is only one aspect of a classroom, it is a powerful piece of the learning environment that teachers increasingly depend on for daily instruction. In order to manage and facilitate best practice of technology tools, many districts utilize an Instructional Technology Facilitator, or an equivalent position, as an instructional coach. In North Carolina, the Instructional Technology Facilitator (ITF) plays an important part in how technology is utilized, perceived, and leveraged to support diverse learning needs. Therefore, like many leadership positions, the ITF can contribute to the disparities that exist within a learning environment or understand the structural inequities in order to empower Black, Indigenous, People of Color (BIPOC) students.

In this article, Critical Race Theory is the theoretical framework to examine the problem statement, which states that technology is not being utilized effectively in K-12 classrooms to actively facilitate equitable representation in instructional technology opportunities and STEM roles. For the purpose of this writing, the author has named "instructional technology opportunities and STEM roles" as access to STEM skills and technology tools in K-12 classrooms as well as how these opportunities correlate with STEM higher education and career pathways. Through the work of two ITFs completing collaborative research in their respective districts in North Carolina, the role of ITFs is explored to demonstrate the importance of their coaching as teachers shift their pedagogy to asset-based centering of their students, especially for students who are historically

underrepresented in technology opportunities. The co-researchers utilized both qualitative and quantitative methods to analyze the impact of the ITF and their use of culturally responsive pedagogy in their coaching.

Literature Review

Through a discussion of Critical Race Theory, Culturally Responsive Teaching, and Universal Design for Learning (UDL), the following sections will help define and ground how educators and educational leaders strive to create inclusive learning environments for all learners, but more specifically, to recognize and address the continued disparities that exist for BIPOC students.

Critical Race Theory: A Theoretical Framework and Methodology

Critical race theory (CRT) is both a methodology and a theory, which is based on race and oppressive structures and the "collective historical experience of our communities of origin" (Parker & Roberts, 2011, p. 78). Critical social research understands socially constructed knowledge and interprets it in order to dismantle oppressive systems (Esterberg, 2002). Social reality defines individual experiences and CRT serves to emancipate marginalized groups and liberate them from oppressive systems. The role of a CRT researcher is to be a "social activist" who actively seeks information needed to dismantle the very inequities they have identified (Rubin & Rubin, 2012, p. 23). By focusing on underrepresented societal voices, critical race theorists can construct knowledge, lift up the marginalized, and work collaboratively to remove barriers that exist within oppressive structures. There are five tenets that are utilized in Critical Race Theory that guide scholarship, pedagogy, and perspective: (a) Centrality and intersectionality, (b) Challenge dominant narrative and differential racialization, (c) Commitment to social justice and

interest convergence, (d) Experiential knowledge and counter-storytelling, and (e) Historical

context and interdisciplinary perspectives (Solorzano, 1998; Delgado & Stefancic, 2012;

Han, 2019).

Centrality and Intersectionality. CRT acknowledges that race and racism are

inescapable as these social constructs are a part of society (Delgado & Stefancic, 2012).

Although CRT's purpose is to emancipate marginalized groups as it names disparities that

exist based on race, the theory states that there will always be oppressive structures in place

with inequities between the dominant and marginalized groups (Parker & Roberts, 2011).

Race is not the only identity that impact someone's lived experience and other identities must

be considered. The term 'intersectionality' was coined in the 1980s by legal scholar,

Kimberlé Crenshaw. Crenshaw says people have various identities such as gender, class,

religion, language, immigration status, and sexuality, that add layers to a person's lived

experience beyond race and can affect a person's reality (Carbado & Crenshaw, 2019).

Challenge the Dominant Narrative and Differential Racialization. As BIPOC

voices have been historically underrepresented, CRT urgently states that the dominant

narrative often misrepresents or fails to represent those who are not white. By considering

how every space is influenced by white supremacy, it is important to note the dominant

narrative or ideology when looking at education and learning spaces. White supremacy, as

described by Aguilar (2020), refers to the "mindset and belief system of white superiority

that has become institutionalized in policy" (p. 7). Differential racialization posits that

"groups of people are racialized in differing ways at differing times" in order to benefit

whiteness, and, therefore, the groups of people in the dominant narrative may change (Basile

& Black, 2019).

Commitment to Social Justice and Interest Convergence. CRT researchers acknowledge that their work exists in educational spaces that function in paradoxical ways with "their potential to oppress and marginalize coexisting with their potential to emancipate and empower" (Solorzano & Delgado Bernal, 2001). As white supremacy and colorblind practices are noted and scrutinized, there is potential for resistance, and, therefore, a commitment to social justice is crucial for CRT researchers. Interest convergence also warns researchers that a commitment to social justice may be influenced by groups of people if it benefits them as well (Bell, 1987; Smith, 2020).

Experiential Knowledge and Counter-storytelling. Experiential knowledge is central to CRT and links this knowledge to interpretive perspectives on race and racism (Parker & Roberts, 2011). Experiential knowledge is valued and trusted within Critical Race Theory as it provides insight based on lived experiences, but also values cultural representations such as cuentos, storytelling, and family histories (Parker & Roberts, 2011). As stated by Solorzano and Yosso (2002), these stories include methods such as "storytelling, family histories, biographies, scenarios, parables, cuentos, testimonios, chronicles, and narratives" (p. 27).

Historical Context and Interdisciplinary Perspective. Historical context, as well as having a variety of perspectives, help give a better sense of an issue or story. Context is helpful when examining the way educational policies and programs have been created or dismantled as these decisions are not made in a vacuum, but rather amid societal historical experiences. CRT is interdisciplinary by incorporating research from ethnic studies, Women's studies, history, law, and education to better understand the intersectional needs of marginalized groups (Solorzano & Yosso, 2002).

Considering Critical Race Theory and by acknowledging that classrooms are structurally inequitable, the following pedagogical frameworks have been utilized to decenter whiteness, create inclusive learning environments, and frame coaching as a leveraging tool towards equity and educational justice.

Culturally Responsive Teaching and Coaching for Equity

When asked how to define Culturally Responsive Teaching, Dr. Geneva Gay, as quoted in a podcast episode by Eakins (2022), she stated that it "attempts to take the general theoretical ideas that we think equals good teaching and do for groups of color what is already being done for the dominant Eurocentric group." Hammond (2015) states that Culturally Responsive Teaching is acknowledging students' unique ways of learning, synthesizing information, and responding "with teaching moves that use cultural knowledge as a scaffold to connect what the student knows to new concepts and content in order to promote effective information processing" (p. 15). Educators must recognize that students come from a variety of backgrounds, which include both individualistic and collectivist cultures. They must also be aware of how a brain responds to an unsafe learning environment, which is a key piece to moving students from dependent to independent learners. In her book *Coaching for Equity,* Aguilar (2020) states that a "transformational coach" can be both aware of the systems that teachers and students are in as well as connect the layers that create frustration for a teacher by providing resources and learning partnerships to take action to support their students (p. 40). Aguilar signals to the importance of a coach in leveraging resources, but also centering students by taking context into account to create new practices. Understanding pedagogical practices that support all learners, such as UDL, is a key tool for coaches to bring to their coaching conversations.

Universal Design for Learning

Initially grounded in supporting neurodiverse students, UDL is a framework of research-based practices that guide teachers through pedagogical decision making (Kieran & Anderson, 2019). These UDL practices were created by researchers in the mid-1990s to bring computer technology to students with disabilities (Doran, 2015). Accessibility through instructional technology became the bridge between the content and supporting learners with disabilities. Today, UDL gives teachers the opportunity to reflect on their pedagogy to ensure that all learners become "expert learners" and gives students strategies on how to be resourceful and goal-oriented (Cast, 2018). Doran (2015) asserts that, "UDL provides a roadmap for educators to think through the process of identifying barriers to learning and working to remove them" (p. 4).

The UDL Framework considers all learning styles and steers away from one lesson or unit for all students. There are three main components of UDL, as described by CAST (2018): 1. Provide multiple means of engagement, 2. Provide multiple means of action and expression, and 3. Provide multiple means of representation. These three components allow for educators to pinpoint a desired instructional need, but also correlates with how students learn. Oftentimes, UDL is connected to special education or accessibility accommodations such as closed captions, voice-to-text transcription, or screen magnification. Cognitive barriers can be more than dis/ability, but also how a student feels centered within the curriculum or learning space. Brown et al. (2021) states, "As the number of students with different cultural background [*sic*] increases in schools, technology has the potential to provide cultural representations of phenomena that matter in their lives" (p. 10). This quote is

a reminder of how culturally responsive use of technology can bring change to students, including those who have been historically underserved.

Gaps in the Literature

The intersectionality of equity, social justice, and innovation within the context of educational technology has come to the surface over the last several years. Though research literature is moving towards inclusivity with regards to pedagogy and instructional technology, understanding how race and ethnicity affect an educator's teaching choices have yet to be a prevalent part of professional development or teacher educator programs. Using CRT allows educators to critically evaluate the normed discourse surrounding instructional technology and pedagogy and identifies it as another system centered around whiteness that continues to marginalize and oppress people of color.

Moving from theory to practice is important to rethink teaching moves and create impact for students. Most of the literature emphasizes the importance of why educators should utilize culturally responsive UDL practices, especially through the use of instructional technology, but may not present explicit pedagogical examples for teachers to reshape their practice. Again, the goal should not be to provide educators with a checklist, but to offer teaching practices that support a paradigm shift to culturally responsive learning spaces that reflect that some students have been continuously marginalized. These themes and theoretical framework are the driving force behind the following research questions with which the author centered their coaching and research.

Methods

Participants

  The co-researchers in this study are both ITFs in North Carolina who serve their districts in different ways and conducted the following research in Fall 2021. For anonymity of all the participants, the respective districts are named District A and District B. District A is located in the Western part of North Carolina in Region 8, and District B is in the Southwestern part of North Carolina in Region 6. Even though both districts are geographically close to each other and have similar demographics, District B has a much larger population of students (Table 2).

Table 2

District A and B Demographic Comparison

Demographics	District A	District B
Number of schools	10	37
Total student population	4,443	20,606
Racial and ethnic makeup	63% white 18% Black/African American 9% Hispanic/Latinx 7% two or more races 1% Asian/Pacific Islander 1% Native Hawaiian/Other Pacific Islander and 1% Native American or Alaska Native	63% white 15% Hispanic/Latinx 14% Black/African American 6% two or more races 3% Asian/Pacific Islander 0.1% Native Hawaiian/Other Pacific Islander and 0.1% Native American or Alaska Native

  The ITF in District A supports two K-5 elementary schools with approximately 670 students while the ITF in District B supports ten K-5 elementary schools with approximately 6,384 students. All participants were K-5 teachers and/or students who volunteered to participate in either surveys, focus groups, co-teaching plans with the ITF, and/or interviews.

Procedure

In order to explore the problem statement that states that technology is not effectively being utilized in K-12 classrooms, the co-researchers used the following three questions to guide their work:

1. What is the role of the instructional technology facilitator in supporting teachers as they use technology to facilitate equitable representation in STEM, both in opportunities and future career pathways?

2. How can an instructional technology facilitator support a teacher in evaluating their pedagogy through an asset-based lens?

3. In what ways can a meaningful learning partnership be cultivated between an instructional technology facilitator, teacher, and student by collaboratively developing a lesson that centers students' voice and choice?

Data Collection and Analysis

The Role of the Instructional Technology Facilitator. In order to answer the first research question, a survey and follow up interviews were conducted with administrators, support staff, ITFs and teachers in both Districts A and B. With a 22% response rate from 72 participants in District A and a 19% response rate from 102 participants in District B, when asked, 'In one sentence, share what you know about the role of the Instructional Technology Facilitator,' most survey respondents recognized the ITF role as instructional support not as much for technical support (Appendix B). Only two respondents did not know what an ITF role entailed. Defining the role of the ITF is important in terms of colleagues knowing how to ask for instructional support and coaching. The survey also asked respondents to share how

often they utilize the ITF for instructional and technical support with once a week, once a

month, once a quarter, once a year, or not at all. District A (Figure 1).

Figure 1

Frequency the Instructional Technology Facilitator Utilized for Instructional Support for

District A and District B
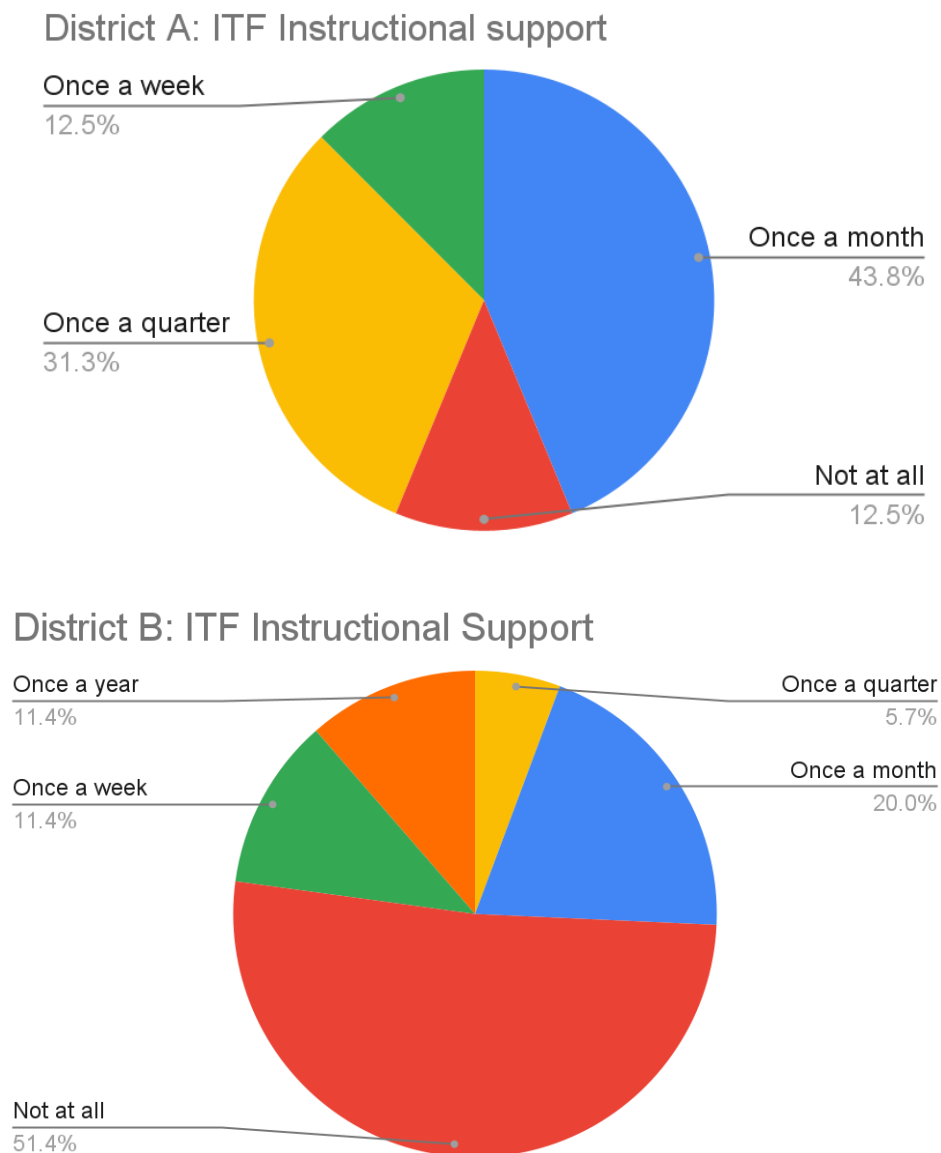
By reviewing both districts in Figure 1, it is clear to see that staff reach out to the

District A ITF more often than compared to the District B ITF. This may be because the

District A ITF is able to serve a smaller population of students and schools as compared to the District B ITF, and is, therefore, more readily available.

Survey participants were asked the open-ended question: "What is the role of the Instructional Technology facilitator in supporting teachers as they use technology to facilitate equitable representation in STEM, both in opportunities and future career pathways?" There were three major themes that surfaced from this question: professional development, resources, and planning (54.9%); unsure what STEM is or how an ITF can support it (35.3%); and disparities and underrepresentation in STEM (9.8%). Of the participants noting disparities or a need for equity in STEM, no one named race or ethnicity explicitly, but rather used vague adjectives. One participant used 'underrepresented populations' while two others used the word 'diversity.' One participant noted the need for equality between 'male' and 'female.' These responses helped the co-researchers understand that messaging on the ITF role, as well as acknowledging the existing disparities in STEM and technology with explicit references to race, ethnicity, and gender, can help give educators context as to why the ITF coaching role is significant in facilitating equitable representation in STEM opportunities and career pathways.

In order to get a better understanding of these responses, the co-researchers completed follow-up interviews with participants who completed the initial survey. Of the 51 participants, seven volunteered to give more insight into their responses. Four participants were from District A and three from District B and all worked as educators or ITFs in a K-5. Through these conversations, it was clear that respondents understood the ITF role as a focus on instructional support rather than technical support. Overall, participants from both the survey and follow-up interviews were able to define the disciplines included in the acronym

STEM, but were less clear on how to integrate it into their classrooms as lead teachers. The ITF was able to refer to STEM resources and how they support their classroom teachers within the core curriculum. Though teachers may be able to identify what the letters in STEM stand for, providing intentional coaching and modeling around STEM challenges and skills would be an appropriate next step. Educators may also need explicit context on the existing disparities that could influence their pedagogical moves.

Teachers in District A completed a school-wide book study over the past two years utilizing the book, *Culturally Responsive Teaching and the Brain* by Zaretta Hammond. Their responses included defining asset-based learning and the importance of centering students' strengths. Furthermore, half of the teachers in District A stressed the importance of having an ITF based at their school versus being shared between schools. They voiced the importance of having an ITF readily available in order to provide one-on-one coaching and co-teaching opportunities.

Overall, it was clear that those who volunteered to respond to the survey and follow-up interviews felt that the ITF plays a key role in supporting teachers as they use technology though they were unsure how to facilitate equitable representation in STEM, both in opportunities and future career pathways themselves. The data identified the areas of opportunities for both researchers as ITFs to support teachers in the classroom, not only with defining STEM and its adaptability within their core content areas, but also to consider ways to demonstrate how to create an equitable, inclusive classroom environment. When considering the open-ended question: "What is the role of the instructional technology facilitator in supporting teachers as they use technology to facilitate equitable representation in STEM, both in opportunities and future career pathways?" the co-researchers found that

the ITF is a key facilitator for supporting teachers in their understanding of instructional technology, its connection with STEM, and a teacher's understanding of current disparities that exist in STEM and technology.

Coaching With an Asset-Based Lens. To answer the question, "How can an instructional technology facilitator support a teacher in evaluating their pedagogy through an asset-based lens?" the co-researchers worked with teachers who committed to working collaboratively to complete a unit of their choice. Utilizing the initial survey, participants in both districts were able to note their interest in participating in a co-teaching opportunity with their respective ITF. The participants knew that working with their ITF meant coaching, co-teaching/modeling, and leveraging their lesson through an asset-based lens with instructional technology. Six teachers from District A and five teachers from District B volunteered to complete a pre and post survey to evaluate their progress in understanding what asset-based and Culturally Responsive Teaching meant for their students and classrooms, a professional development session on culturally responsive UDL, and a Coaching Work Plan (Appendix C). After initial coaching sessions, both researchers led a professional development (PD) on Culturally Responsive Reaching with an asset-based lens utilizing a UDL model for all participating teachers in their respective districts. This one-time PD helped define asset-based learning and UDL and gave teachers an opportunity to reflect on ways that their lessons leveraged instructional technology in order to meet the needs of all students.

Figure 2 displays the results of the pre and post survey of District A and District B separately. The pre survey was completed by teachers prior to completing coaching work plans, completing a professional development session on culturally responsive UDL, and co-teaching with their respective ITF. The post survey was completed by teachers after the

named activities above were completed and after working collaboratively for approximately three months during Fall 2021. The pre and post survey was intended to gauge the teachers' understanding of asset-based and Culturally Responsive Teaching. It also evaluated their ability to find research-based resources to support asset-based and Culturally Responsive Teaching practices. As mentioned earlier, District A had completed a book study on *Culturally Responsive Teaching and the Brain* by Zaretta Hammond, where terms such as asset-based and culturally responsive were defined. District B were not exposed to these terms in an official way prior to the pre survey. Figure 2 demonstrates that teachers in District A felt more confident in their answers than District B, which can be attributed to the book study they completed prior to this research. Though the teachers all showed growth in both districts, it is important to note the growth made in District B, where their post survey results were comparable to District A. This demonstrates that growth can happen for educators when receiving intentional coaching around culturally responsive UDL, regardless of what previous exposure the educator has received. It is clear that an ITF can directly impact an educator's growth surrounding culturally responsive UDL through coaching and co-teaching support.

The pre and post survey also included open-ended questions that were centered on defining what teachers initially defined as asset-based teaching. In the pre-survey, in District A, 4 out of 5 teachers (80%) participants were able to define asset-based learning. In District B, none of the teacher participants were able to define the meaning of an asset-based learning model, however, they responded with an excitement to learn more.

Figure 2

Pre and Post Survey on Asset-Based and Culturally Responsive Teaching for District A and B

District A: Pre and Post Survey on Asset Based and Culturally Responsive Teaching

District B: Pre and Post Survey on Asset Based and Culturally Responsive Teaching
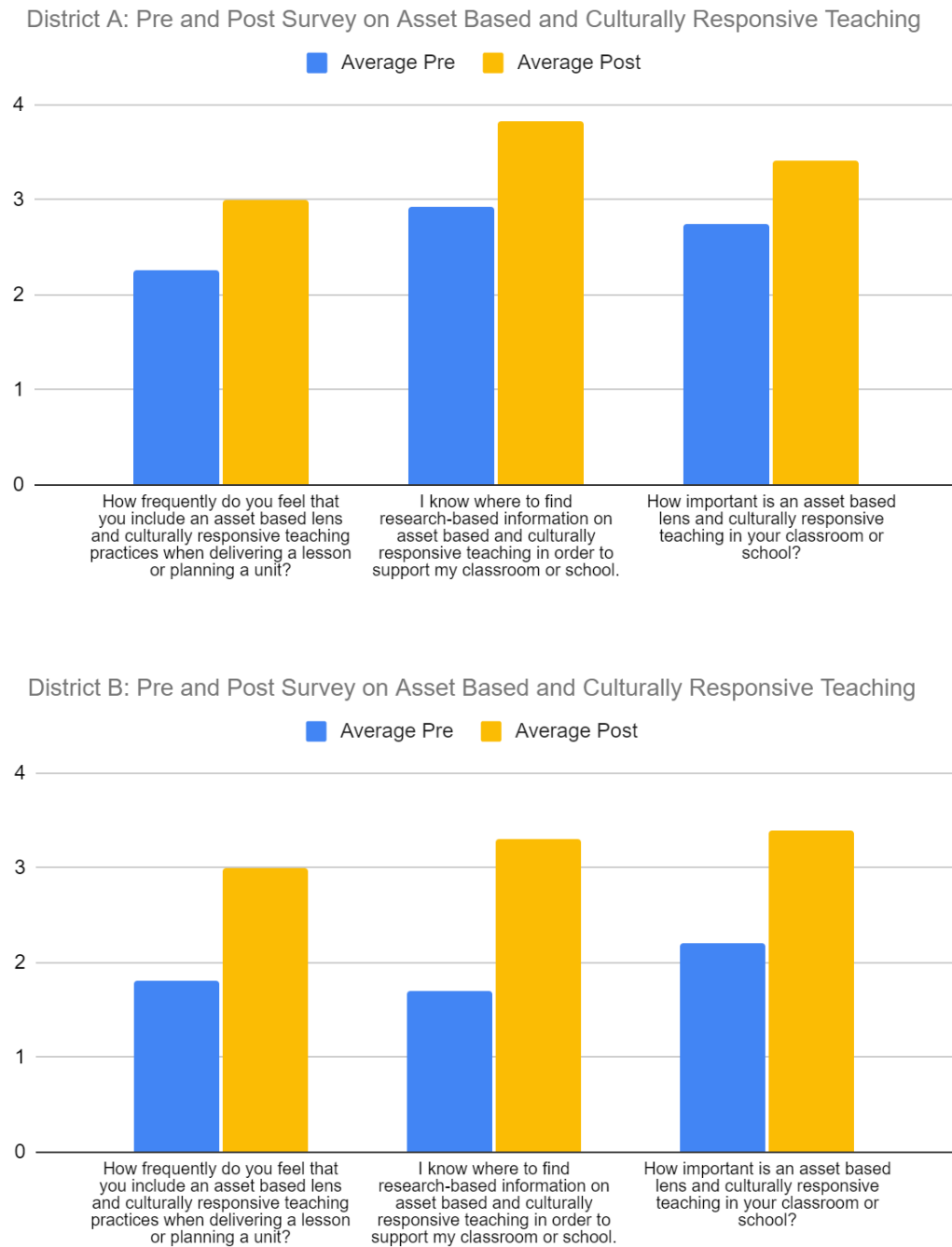
Co-researchers utilized a Coaching Work Plan (Appendix C) in order to guide their coaching conversations and ground themselves with the North Carolina content standards as well as the North Carolina Digital Learning Standards for Students. The Coaching Work Plan provided clear expectations on the role of the coach, teacher, and student in order to center student strengths. Both the teacher and the coach worked collaboratively to complete the Coaching Work Plan and allowed for collaborative progress throughout their process. Each of these lessons and how they centered student strengths are included in Appendix D.

Throughout, the co-researcher took field notes that were not shared with the teacher or students to make note of anecdotal experiences in a coaching session, a classroom lesson where the coach interacted with the teacher and/or students, or to make note of considerations the coach might need to make. These field notes allowed the ITFs to refer to their interactions with students, teachers, or takeaways from their coaching sessions or teaching moves that occurred over several weeks in Fall 2021. Table 3 highlights the key strategies or instructional models that the researcher noted when coaching a teacher or co-teaching. Some of these quotes came from direct conversations or from observations the coach made that influenced their next steps in coaching. Field notes allowed the ITF to reflect on their work and take note of ways they can push to make the learning environment more inclusive to all students. The co-researchers were intentionally looking for ways historically marginalized students had access to the technology tools, were perceived by the teachers, and utilized pedagogical strategies or instructional models to support the classroom teacher with an asset-based lens.

Table 3

Pedagogical strategies and instructional models utilized during coaching work plans

Pedagogical strategies and instructional models	Example Quotes from Field Notes
UDL strategies (engagement, representation, and action and expression)	"One student said, 'This is really cool! I like that my teacher can help me find where to go because I need help sometimes and have to wait and miss directions sometimes.'" "It was clear that student choice had them hooked into the writing, especially knowing they would be recorded.[...] There was one young man who I've seen "asleep" in this class before and was revising and ready to rerecord their episode due to mistakes." "Students were all engaged and excited about their work."
Deficit versus asset-based lens	"She did mention ELL student as being unable to meet the goal, but hoping to show growth by providing something different." "She talks about students in a way that is asset-based and gives them many opportunities to join rather than expect compliance (she mentioned that 6 years ago, that's what she demanded and it caused unnecessary conflicts/power struggles). She speaks about her students in a way that demonstrates every student has something to offer and therefore, capable of being successful in her class." "It goes to show that our perceptions of students, coaches included, can underestimate a student's potential."
Co-teaching and coaching support	"She was present and able to use the same language or point out the features I referred to when students were exploring independently. This is a great example of co-teaching, where the ITF and the teacher work together to facilitate learning rather than the ITF leading an activity while the teacher leaves. This means that the ITF is able to support the students and teachers simultaneously by providing classroom management support and targeted skills for the students, and pedagogical practice for the teacher." "[The teacher stated] 'I'm not sure if I would have made this happen in an intentional way if it weren't for working with you.' [We] have worked together for years in a collaborative way, but this is the first time she wanted feedback on a lesson without me helping teach it." "My feelings after today were that if I did a PD on this lesson I think [the teacher] would be excited about it, but not really take it back and try it. Being able to go into the classroom and teach alongside

	her is more personal for the teacher's growth and to see in real time how it works."
	"[The teacher stated] I always forget to give them a chance to present or share their work at the end of a big project. So this [coaching] really helped in making sure I didn't fizzle out before students got a chance to do that."
Naming race and culture	"[The teacher] had mentioned how she intentionally wants her white students to hear about the lived experiences of her students of color. She has noted that in her own experience she doesn't have BIPOC folks that she regularly hangs out with, which centered her perception of lived experiences in whiteness. The language this teacher used made it clear that she felt comfortable enough to name race as an identity and seemed to be a key motivator for her in ensuring student voice is given space."
	"Teacher pointed out a houseless student and said 'he's a Black boy' and wouldn't know how to use his device due to lack of prior experience. Decided THIS would be my focus; made note about how to address this during the asset-based training and UDL"
	"Every student that was referred to with a deficit-based connotation was a student of color."

Referring to the initial question, "How can an instructional technology facilitator support a teacher in evaluating their pedagogy through an asset-based lens?" the author felt that a variety of tools are necessary to define asset-based, Culturally Responsive Teaching, but also to make decisions during their coaching session that can help teachers navigate their new pedagogical approach. Reflection time for the ITF is also a crucial piece to be able to continue to support the teacher and students as they learn a new tool and approach while noticing the impact it may or may not have on historically marginalized students.

Race was not ignored, but rather an intentional consideration by the ITF during this process. Using a critical race lens required the ITF to center who was being excluded or supported throughout the lesson and having that centered in the field notes allowed for a shift in the ITF's co-teaching support. For example, "Every student that was referred to with a

deficit-based connotation was a student of color," was an important private note that guided the ITF to approach their own co-teaching moves. In this specific example, this influenced the ITF to work more closely with a specific student that was being perceived with a deficit-based lens when both the teacher and ITF were floating around to support collaborative work. The ITF provided scaffolded support for students to successfully complete the task and, with permission from the student, shared their work, along with others, as part of the closing. By highlighting the work and strengths that the students of color brought to the assignment, the ITF can offer implicit as well as explicit coaching conversations around how their students of color are seen by the teacher and their peers. Aguilar (2020) talks about the Transformational Coaching model, which includes the 'recognize impact' step in order to provide the educator with support around racial and gender identity development and white supremacy, and how they exist in systems, beliefs, and teaching moves. Aguilar states, "It's essential to explore how dehumanizing ideologies harm everyone-including the client [educator]" (p.43). Further trust building would be needed to have intentional, explicit coaching conversations around race and microaggressions that were not able to happen during this coaching session example. The Coaching Work Plans and culturally responsive UDL professional development directly demonstrated the second question, which stated, "how can an instructional technology facilitator support a teacher in evaluating their pedagogy through an asset-based lens?" By coaching with an asset-based lens, the teachers were able to define asset-based teaching and apply this understanding during coaching work plans.

Centering Student Voice and Choice. The question: "In what ways can a meaningful learning partnership be cultivated between an instructional technology coach,

teacher, and student by collaboratively developing a lesson that centers students' voice and choice?" was explored through individual coaching work plans as well as both student and teacher focus groups sessions. Much of what was established in the individual coaching work plans was how student voice and choice were the center of decision making. UDL reminds educators that the first piece to 'Engagement' is through checkpoint 7.1, "Optimize individual choice and autonomy" (CAST, 2018). By centering students and their assets, students are more invested in their learning as well as proud of their completed work (CAST, 2018). Engagement is the first step or 'hook' into bringing a lesson to life for students. Through their coaching sessions, teachers were able to consider UDL and centering students. One teacher delivered a survey to see what tools students prefer to use as well as what tools they want to learn how to use. Another teacher utilized cards with four strengths labeled on each for students to select their strengths, but also to create collaborative groups that had one of each strength represented. During field notes, the co-researchers were able to note the pedagogical shifts that happened because the ITF brought the conversation to how the tools can be used to center students, not how the tools can deliver the content. Every teacher that worked their respective ITF utilized the idea of student choice in many ways, whether it was through a choice board or by asking students what tools or activities they would want to learn to use through an interest survey.

As the students engaged in the work with both the ITF and the classroom teacher, it was important to center student reflections by having small groups of students participate in focus groups. The co-researchers each met with two student focus groups with 5-7 students in each group from their respective districts. The co-researchers also facilitated a focus group involving all teachers who participated in the coaching sessions in Fall 2021. Table 4

demonstrates the questions asked and provides either general statements made by the groups or direct quotes made by either students or teachers. The intent of the focus groups was to gather the student and teacher perceptions of instructional technology, whether it supported their learning or instruction, and how the experience of co-teaching with the ITF affected the outcome of the lesson/unit. Students were able to voice ways they enjoy using tech in their classrooms and how they felt about having a tech integrated lesson. Students described feeling "excited" whereas teachers described feeling "overwhelmed" or "uncertain" as the lesson was new for them. Although teachers acknowledged that students could demonstrate their strengths by centering students with the use of instructional technology, it does require extra effort to meet, plan, and implement a new lesson or unit. Overall, both students and teachers that participated in the lessons and units that were supported by the ITF felt that the experience was valuable, especially since it was clear that students were more engaged and vested in the projects themselves. Some students stated that having an ITF co-teach with their teacher allowed for another opinion and described the value of a meaningful learning partnership between teacher, coach, and students.

Table 4

Focus group qualitative themes from students and teachers

Question	Themes from student focus group	Themes from teacher focus group
Thinking back of what we have discussed today, how can technology be used to highlight your *[or your students']* strengths?	Immersive tech like VR/AR helps for 'hands-on' learning Enjoyed learning more ways to use a device or tool Helps with communicating better (writing versus speaking)	Students were able to shine in different ways based on their strengths Tools like Flipgrid enabled them to process their individual thoughts without being influenced by peers
For students: When the lesson was introduced in your class that included my help, how many of you were excited about the assignment? Were any of you bored with the assignment? Why or why not? *For teachers:* When the lesson was introduced to your students, how many of you were excited about the assignment? Why or why not?	Excited for student choice Excited to work with other students Seeing the ITF meant they were going to have "fun with tech" None mentioned being bored or reluctant about the assignment	Overwhelmed and uncertain because of the new tool/lesson, but felt supported with ITF Project was able to be completed because of the ITF's support Excited to take a lesson to another level Teacher was able to see how providing activities with student choice and voice had the students engaged in learning
How did you feel at the end after the assignment was complete?	Proud of their work Motivated to revise mistakes for a better final presentation Felt like the understood content better	Felt like students took more ownership of their work Felt like all students could benefit from asset-based lessons with integrated tech, not just high flyers
What else do you want to share with me as your ITF?	Having another adult in the room during a project/lesson helps with "voice" since there is another opinion	Processing and planning with ITF allowed for redefinition of their lesson Co-teaching is more valuable than sitting in a PD

The co-researchers noted the themes above after comparing all focus group notes. These themes demonstrate that meaningful learning partnerships can be cultivated between an instructional technology facilitator, teacher, and student when they collaboratively develop a lesson that centers students' voice and choice, as asked by research question number three. Students and teachers noted that more engagement, depth, and understanding was enabled when students were part of the lesson creation process.

Conclusions

Technology and Pedagogy Are Not Inherently Good or Neutral

Through the Coaching Work Plans and Field Note observations as well as supporting literature, the author was able to conclude that technology tools and teaching moves are not inherently neutral, and, therefore, require strategic approaches towards ensuring all students can access content, curriculum, and their learning tools. Classroom spaces will continue to exclude or limit students, especially those who have historically been underserved, if careful attention to how students are centered is not taken. When considering the racial dynamics of the educator, ITF, students, and their school culture, as a coach, it is important to ask whether every student is being centered and uplifted. Using Critical Race Theory allows an ITF to acknowledge that instructional technology, when used without clear intentionality, can be refused, limited, or discouraged, though they may be the very tools needed to provide more context and engaged learning. When a teacher decides to use an instructional technology tool for certain students because they were 'earlier finishers' or demonstrated good behavior, it means that there will always be students that will not be able to have the same learning experience. When a teacher presents the content in a uniform way and does not allow for multiple means to process or synthesize information, then their assets are not being uplifted.

Having access to an ITF, who can consider a lesson or unit with a critical lens, can make an impact on how a teacher can shift their teaching and center their most marginalized students in the classroom.

District Use and Support of the ITF Role Can Affect Classroom Support

As established earlier, District A and District B utilize their ITFs in different ways due to the size and financial allotment to the positions in their districts. District A staff have frequent access to their ITF for co-teaching, coaching, or overall support as their ITF is assigned to one or two buildings. District B staff have scheduled times to expect their ITF or must schedule time in order to receive coaching or to have co-teaching as that role supports ten K-5 schools. Though the first survey establishes an understanding of the instructional support of the ITF, it is clear that District B utilizes their ITF less often for instructional support as compared to District A (Figure 1). District B's more limited access to their ITF may be a cause of this.

Though professional development is also a component of the ITF role, where instructional technology tools must be introduced or demonstrated to many staff members at a time, co-teaching and coaching allows for tailored support specific to the teacher and classroom. Through this experience, the co-researchers noticed that setting up coaching sessions with clear expectations and time to process enabled for the lesson or unit. Teachers felt accountable to the established coaching work plan, but also supported by the ITF by having those roles distinguished. Coaching conversations allowed for the ITF to center students and refocus the priority on how to leverage tools in order to utilize students' strengths rather than deficits. These conversations may vary in length based on the need or schedule, but are vital to ensuring the ITF can support the teacher and classroom. This also

means that having an ITF available for informal or formal check-ins for teachers is key and should not vary from district to district. Districts should consider how their ITFs are being utilized in order to evaluate best practices and inclusive use of instructional technology. ITFs should also be provided on-going professional development on coaching and how their own beliefs and understanding of racism influences their coaching work (Aguilar, 2020).

"Tech Can Level the Playing Field"

As educators reflect on their integration of technology, it is important to note who has frequent access to complete the higher-level thinking with technology. By having technology be an integral piece of daily instruction, especially by synthesizing information in different ways, all students can have access to learning new content. In an attempt to provide space for compassionate connections, one teacher found that technology became that vehicle rather than a barrier to access. As they stated in their focus group conversation:

> "In my class, my students do not get along very well. For them to have to sit down together and type it out. They actually worked together more than they argued, I feel like with that technology piece in there, it brought them to a level playing field instead of worrying about handwriting or answering questions."

It is important to acknowledge that instructional technology can act as either a barrier or as a doorway to learning opportunities (or potentially both, depending on the situation), based on how a teacher chooses to center the tool. Educators cannot expect that a technology tool will 'level out the playing field' on its own, but rather that educators themselves can empower students' learning by providing culturally responsive and thoughtful instruction. Can barriers to writing be eliminated by incorporating technology tools instead? When can students be provided opportunities for collaboration, critical thinking, communication, and

creativity that engages all students? 'Leveling the playing field' means educators and coaches must equitably consider the needs of each student at all times.

Unlearning Pedagogy From Teacher to Student Centered Takes Time

Educators and educational leaders are often learning and growing from their experiences and mistakes. Many teachers will express how unsure they felt in their first few years of teaching or coaching. Being in a teaching or coaching role takes time to develop and understand, especially as a better understanding of how those roles exist in inequitable systems like education. Seeking intentional learning is crucial, especially when the 'normed' culture of a classroom is centered around whiteness. Unlearning deficit-based pedagogy from an educator's own lived educational experiences and shifting to an asset-based lens that centers a variety of students takes time. As a result, that critical self-reflection, instructional coaching, and access to professional development that considers historically marginalized students need to be added to the toolkit that help shape teachers into the best facilitators of equitable learning in classrooms. As Aguilar (2020) states:

> "Educational equity means there is no predictability of success or failure that correlates with any social or cultural factors-a child's educational experiences or outcomes are not predictable because of their race, ethnicity, linguistic background, economic class, religion, gender, sexual orientation, physical and cognitive ability, or any other socio-political identity marker." (p. 6)

Though educational equity may seem unattainable, every lesson, unit, and school year is another opportunity to reshape individual implicit biases, personal lenses, and provide the best learning environment for every student. Acknowledging inequities means making intentional shifts in pedagogy, and educators should strive for progress, not perfection.

Limitations

Conducting Research During a Global Pandemic

Since March 2020, many districts, teachers, and students still find themselves navigating the demands of schooling during a pandemic. Many hoped that the 2021 school year would provide normalcy, but frequent absences, cancellations of school wide events, and impromptu moves to distance learning have continued to make 2021-2022 stressful for all. Completing research in Fall 2021 was not as easy as one would hope, but the co-researchers were able to work with teachers who were willing to stretch themselves, despite the obstacles they faced. As ITFs, the co-researchers balanced what was needed for research and what was needed by the classroom, which is a common balancing act for those in leadership roles. The co-researchers reassured their participants that the coaching work would feel the same, but with added note taking to document the process. The co-researchers made sure that the interviews, surveys, professional development, coaching meetings, and focus groups were not an undue burden for teachers or students to participate in. The co-researchers valued the precious time educators provided in order to discuss, process, and stretch current practices.

Teacher burnout continues to affect schools across the country. Of the 6,000 teachers who responded to a survey conducted in November 2021 by Teachers Pay Teachers, almost half (48%) stated they were considering changing jobs (Perna, 2022). Similar findings from a survey conducted in 2020 by the National Educators Association (NEA) stated that one in three teachers were interested in retiring early or resigning in light of the COVID-19 global pandemic (Flannery, 2020). The co-researchers did not want to push teachers so far out of their comfort zone that the lesson or unit would be overwhelming. Talking about race and

racial bias takes an emotional toll and requires self-reflection that some may not be able to process well during a stressful school year. Though some teachers were able to name race and racial inequities on their own, the co-researcher made note of the statements or observations that would require further follow up with teachers who were not always able to happen.

Developing trusting coaching relationships takes time. The co-researchers not only have differences in coaching experience, but are also continuing to support schools and classrooms with the technical needs of instructional technology, especially as remote learning is still a reality for K-5 schools. The trust required to critically evaluate pedagogy requires intentional coaching work time, including collaborative reflections that can be difficult to carve out time for. Having spent two years in a technical support role due to remote learning, the co-researchers are continuing to recenter their roles as instructional coaches. Further research with a long-term coaching analysis would be key to see how coaching over time can be leveraged to create equitable learning spaces.

Limited Number of Teachers and Students

The first survey the co-researchers sent out to their respective districts was sent out September 2021, when teachers were attempting to recalibrate what face-to-face instruction during a global pandemic looked like. The co-researchers felt that there should have been a higher response rate and made sure there were many opportunities for all potential participants. Email reminders, announcements during professional development sessions, and printed flyers were distributed to increase the response rate from both districts. Though the response rate was lower than anticipated, the number of teachers who volunteered to participate in the coaching sessions felt appropriate for the co-researchers in order to provide

them with the individualized coaching sessions needed. The co-researchers acknowledge the

hard work required to make a shift in pedagogy and are grateful for the time and effort from

every participating educator and student.

Chapter Five: Addressing the Gender Gap in STEM Education by Utilizing the

Instructional Technology Facilitator Role in Elementary Classrooms[4]

Wojcicki, CEO of YouTube, states, "From phones to cars to medicine, technology touches every part of our lives. If you can create technology, you can change the world" (Code.org, 2021b). Students of today have grown up utilizing technology as a tool that they can use to learn, explore, and communicate. The challenge for integrating technology in an education setting lies in how schools use technology tools to enhance their learning with intentionality by not only integrating technology into the classroom curriculum, but also making sure it is done in an equitable way.

STEM (Science, Technology, Engineering, and Math) education can offer teachers a way to integrate technology into their curriculum, however, there are still ways in which improvements can be made to ensure this is done in an intentional way. School districts across the nation, and specifically North Carolina, employ specialists known as Instructional Technology Facilitators (ITF) to assist teachers with integrating technology and STEM education in a purposeful way. The ITF role encompasses both providing and sustaining classroom technology with access and pedagogical best practice. ITFs are expected to keep up-to-date on new technologies, how they can be utilized, and integrated into classroom instruction. This article will address how an ITF can assist teachers with integrating

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[4] This chapter will be sent to the journal, *The Elementary STEM Journal*

technology with STEM opportunities and roles in their curriculum using an asset-based approach to provide an equitable learning experience for all students in their classroom.

Literature Review and Theory

STEM Education in K-12

The STEM acronym was first used in 2001 by the director of the National Science Foundation's Education and Human Resources Division. STEM refers to the integration of science, technology, engineering and mathematics in curriculum instruction (Breiner et al., 2012). In recent years, STEM has become a buzzword throughout education, and many have worked to define STEM for classroom instructors to provide students with the education necessary to compete globally. In some schools STEM can be a makerspace opportunity to create and design from a variety of materials. Other classrooms might fully integrate STEM into their curriculum in a seamless way, while another school may be less systematic in their approach. One major concern is how STEM has not been well defined across the nation and even across each state as to what represents STEM and how it looks in the classroom setting. The U.S. STEM Education Report found the main issue facing the STEM movement is defining what STEM means and how to incorporate it in K-12 classrooms (Granovskiy, 2018).

The role of the classroom teacher is crucial in how the curriculum in their classroom is delivered and the learning environment they create for their students. Ingen et al. (2018) noted, "researchers have long understood that, of the factors that a school district can influence, the classroom teacher has the greatest impact upon student learning" (p. 9). The teacher's vital role can be considered as the gatekeeper to student learning. Ensuring that teachers are well trained in STEM educational curriculum can not only provide a way for

teachers to be better prepared to implement STEM, but it can also provide an environment for students to feel included and safe to learn new things.

The classroom environment the teacher creates can also play a major role in how students engage in the learning experience. In classrooms, students perceive messages about their social roles from both overt and subtle influences. The role of the teacher is crucial in providing an all-inclusive environment for students to feel comfortable learning, especially in STEM education. None of the research implies that teachers are purposely discouraging students in STEM, however, Saucerman & Vasquez (2014) found that teachers can "convey messages about gender stereotypes to students even if they are not aware that they are doing so" (p. 47). A stereotype threat occurs when someone feels that the negative stereotype about a particular action or group will apply to them (Saucerman & Vasquez, 2014). For example, in a typical STEM classroom, this can affect the participation of female students in the lesson. In a recent study on stereotype threat in the science and mathematics classroom, Sparks (2016) pointed out, "studies have shown that female students in STEM fields are more likely to experience stereotype threat and have higher rates of attrition than their male peers" (p. 11). Some of the factors that can enhance female participation in the STEM curriculum can be the way the classroom environment is set up, the teacher's understanding of gender biases in STEM, and understanding stereotype threat.

Gender Performativity

Identifying as a girl offers challenges such as gender normalization that every girl is expected to act and behave in a particular way. Wearing feminine colors, dresses, jewelry, or makeup can all be included as 'normal behavior' for a girl. Butler identifies this behavior as gender performativity. Being a boy or girl doesn't determine your behavior, instead people

learn to behave in certain ways to fit into society (Young, 2016). So how does gender performativity alter how people perceive girls and women in society?

From the time of conception, parents can be eager to know if they are having a boy or girl. Awaiting confirmation of gender means the parents can begin preparing a room, collecting outfits, and buying toys that would be gender specific depending on their child. A doctor's announcement of the child's sex is determined by the absence or presence of male anatomical parts, but what does this normed announcement from a doctor mean and why does it matter? Butler describes gender identification as a "performative initiated script that governs and gives rise to the performance of and on the body" (Young, 2016). By knowing whether the child is a boy or girl, initiates the performative ways in which the child will be seen as a cisgender, normative role associated with that gender. Societal expectations on these gender roles go beyond the color of their nursery, but can have an impact on their education and careers.

Sexism in STEM

Sexism is the stereotyping of women based on their sex. bell hooks, an American author and scholar whose work examined the connections between race, gender, and class has written several books to focus on this subject. hooks (2000) states that feminism is, "a movement to end sexism, sexist exploitation, and oppression" (p. ix). hooks stated that, in feminism, people could find an end to sexism as a society. Like Butler, hooks knew that society created the space in which females were to play their part and her work can be transferred to the classroom environment as well.

The STEM movement is directed towards preparing students for a job market and society that can be globally competitive. However, studies have shown that not all students

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are pursuing STEM opportunities of learning due to their gender. Robnett & John (2018) published a study about the sexism that is present in the STEM classroom. They found, "eradicating sexism from STEM fields hinges on people acknowledging that sexism can create challenges for girls and women who are pursuing STEM careers" (p. 231). In their study, they found that the barrier for females participating in STEM fields and careers was due to the feeling that they didn't belong. Why are these gender interest stereotypes so powerful? Master et al. (2021) found that girls going into the computer science field were affected by stereotyping and could "[...] shape students' perceptions of whether they would belong with others in that field" (p. 5). When creating the classroom environment with STEM instruction, it is important to understand the effect stereotype threats and sexism has on female students.

Gaps in the Literature

As STEM becomes more prevalent as a focus throughout education, it opens the door to many different fields of study and work that were not around prior to the 21st century. Ahmed (2017) describes the notion as, "not naming the problem in the hope that it will go away often means the problem remains unnamed. At the same time, giving the problem a name does not make the problem go away" (p. 34). When an inequity is discovered, pretending it does not exist will not make it go away. The easy thing is to look the other way, however, there is no accountability in that action. In educational leadership, addressing the problem by naming it is the first step toward change and where the work lies.

The gender gap in STEM has been identified in scholarly literature over the past 10 years, however, now is the time to address how to create the changes needed. The classroom teacher's role puts them in the driver's seat for change. First, there needs to be a clear

understanding of STEM education and how to implement it into their instruction. Providing professional development and licensure options at state levels can aid in the understanding of STEM on the instructional level.

Second, addressing how to provide an inclusive environment in STEM education that pays close attention to the identified gender and racial gap. Providing a classroom environment that offers equitable contribution and opportunities no matter each student's gender with an understanding of the barrier stereotype threat and sexism can cause female students. Saucerman & Vasquez (2014) concluded, "none of this research implies that teachers intend to convey messages about gender stereotypes to the students or that they are even aware that they are doing so" (p. 49). Addressing the gender and racial gap issue in STEM is an intentional practice and without naming the barriers, the literature will continue to discuss the issue and not address it.

Methods

Participants

The data from this study was collected by two ITFs in two different school districts in North Carolina. District A is located in the Western part of North Carolina. District B is located in the Southwestern part of North Carolina. Both districts are relatively close in their location and demographics, however the number of schools, students, and operational infrastructure differ (Table 5).

Table 5

District A and B Demographic Comparison

Demographics	District A	District B
Number of schools	10	37
Total student population	4,443	20,606
Racial and ethnic makeup	63% white 18% Black/African American 9% Hispanic/Latinx 7% two or more races 1% Asian/Pacific Islander 1% Native Hawaiian/Other Pacific Islander and 1% Native American or Alaska Native	63% white 15% Hispanic/Latinx 14% Black/African American 6% two or more races 3% Asian/Pacific Islander 0.1% Native Hawaiian/Other Pacific Islander and 0.1% Native American or Alaska Native

All participants were K-5 teachers and/or students that volunteered to participate in either surveys, focus groups, co-teaching plans with the Instructional Technology Facilitator, and/or interviews.

Procedure

After reviewing the literature and identifying the gaps presented, the authors did a collaborative study to determine ways technology use in the classroom can bring equity and change in STEM education. The driving research questions for the study were:

1. What is the role of the instructional technology facilitator in supporting teachers as they use technology to facilitate equitable representation in STEM, both in opportunities and future career pathways?

2. How can an instructional technology facilitator support a teacher in evaluating their pedagogy through an asset-based lens?

3. In what ways can a meaningful learning partnership be cultivated between an instructional technology facilitator, teacher, and student by collaboratively developing a lesson that centers students' voice and choice?

Each research question is intended to evaluate the effects of technology integration on gender and racial issues in STEM that have been identified from the literature. In order to integrate technology, the use of the Instructional Technology Facilitator was used.

Supporting Students Equitably in the Elementary STEM Classroom

The first objective of this study was to support teachers in creating an equitable representation in STEM instruction by integrating technology with the assistance of the Instructional Technology Facilitator (ITF). In order to evaluate the understanding of the STEM curriculum in each district, the role of the ITF, and to gauge the importance of equitable representation in STEM, a survey was conducted in both districts. There were 51 total responses with 16 responses from District A and 35 responses from District B, with a 22% response rate from 72 participants in District A and a 19% response rate from 102 participants in District B.

Participants were asked to define what STEM meant in one of the open-ended questions and most of the responses for this question defined STEM with a surface level understanding rather than an instructional approach. Three respondents did not know anything about STEM. Seven participants responded with STEM as a pedagogical approach. From this data, it was confirmed in both districts that a clear understanding of STEM needs to be defined in order to prepare teachers with a concise direction for their STEM instruction.

Another question included in the initial survey was defining the role of the ITF. Through a qualitative analysis of the data, three themes emerged: Professional Development, planning, and resource, uncertainty of STEM and how the ITF can offer support, and the disparities and underrepresentation in STEM. As can be seen in Table 6, most participants (28) were able to define the ITF role as a supportive coach that assists with integrating technology in the classroom. There were 18 participants who identified they did not understand STEM career pathways and opportunities or how the ITF could support their implementation of STEM into their classroom curriculum. Very few participants (5) identified a need for equity in STEM and the role the ITF can play in that change. No one named race or ethnicity in their responses. One respondent mentioned 'underrepresented populations', one respondent mentioned equality between 'male' and 'female'. Two people mention the word 'diversity' in their answer, but it wasn't clear whether they were referring to race and ethnicity with that statement. The data identified the areas of opportunities for both researchers as ITFs to support teachers in the classroom, not only with defining STEM and curriculum integration, but also considering how to equitably create an inclusive classroom environment.

Table 6

Role of ITF to facilitate equitable representation in STEM opportunities and career pathways

Theme	Example Quote	Frequency, *n (%)*
Professional development, planning, and Resources	"The ITC [ITF] should help the teacher in locating and developing resources to support STEM instruction. Teachers need more PD to instruct students with regard to the state's student technology standards requirements. This instruction should support teachers in providing opportunities, diversity, and equality in showcasing both male and female students' aptitude towards math and science and future career pathways"	28 (54.9)
Unsure what STEM is or how an ITF can support it	"I think the ITC [ITF] can provide the technology and support the lesson implementation the classroom, but I'm not sure what their role in facilitating equitable representation in STEM looks like."	18 (35.3)
Disparities and underrepresentation in STEM	"Instructional Technology Coaches can be effective in not only offering PD which draws attention to disparities in education and the stem career field, providing opportunities which support equity, and presenting opportunities for increased visibility of diverse figures. "	5 (9.8)

After the initial survey, respondents had the opportunity to participate in a follow-up interview with the researchers. Questions on the follow-up interview were intended to gather a more in-depth insight into how the ITF could support teachers and students in STEM instruction and inclusion. There were 7 teacher participants who took part in the interviews, with 4 from District A and 3 from District B. The data from the teacher interviews showed that teachers were looking for ways the ITF can, "find resources that connect to what we're doing already [content connections]", provide "easily accessible lessons to teachers for equitable STEM instruction" and "Any suggestion and support that could be offered". Teachers needed the support from the ITF to understand STEM integration in an equitable manner and also the support of co-teaching to see how the integration was modeled. The conclusion was that teachers in both districts are looking for a way to integrate technology

into their curriculum while offering a way for students to actively participate in their learning, but support is needed through this process and paradigm shift.

Viewing Students Through an Asset-based Lens

From the initial survey, participants self-identified if they would be willing to participate in a co-teaching opportunity to work with their districts' ITF and create a lesson for their students infused with technology. As ITFs, the researchers know how engaging technology is to a classroom environment, and wanted to integrate technology into each lesson, along with incorporating asset-based learning. There were 11 teachers, with 6 from District A and 5 from District B, who participated in the co-teaching opportunity. Both ITF researchers met with teachers to gather an understanding of the curriculum that each teacher was currently teaching and would like technology integrated into. After the initial meetings, both researchers led a professional development (PD) on Culturally Responsive Teaching with an asset-based lens utilizing a Universal Design Learning (UDL) model. Universal Design for Learning (UDL) is a framework of research-based practices that guide teachers through pedagogical decision making to ensure all learners access learning (Kieran & Anderson, 2019). Before the PD session, participants were asked to complete an anonymous survey on their knowledge of asset-based learning and UDL, how they could incorporate it in their classroom curriculum, and the importance and confidence they felt of utilizing both asset-based and UDL. Questions on the survey collected Likert scale ratings along with open ended responses from each teacher about their previous knowledge of culturally responsive pedagogy and teaching using an asset-based lens. Figure 3 provides a visual representation of the responses from the pre and post survey results from both districts.

Figure 3

District A and B Pre and Post Survey Results on Asset-Based and Culturally Responsive Teaching

District A: Pre and Post Survey on Asset Based and Culturally Responsive Teaching

District B: Pre and Post Survey on Asset Based and Culturally Responsive Teaching
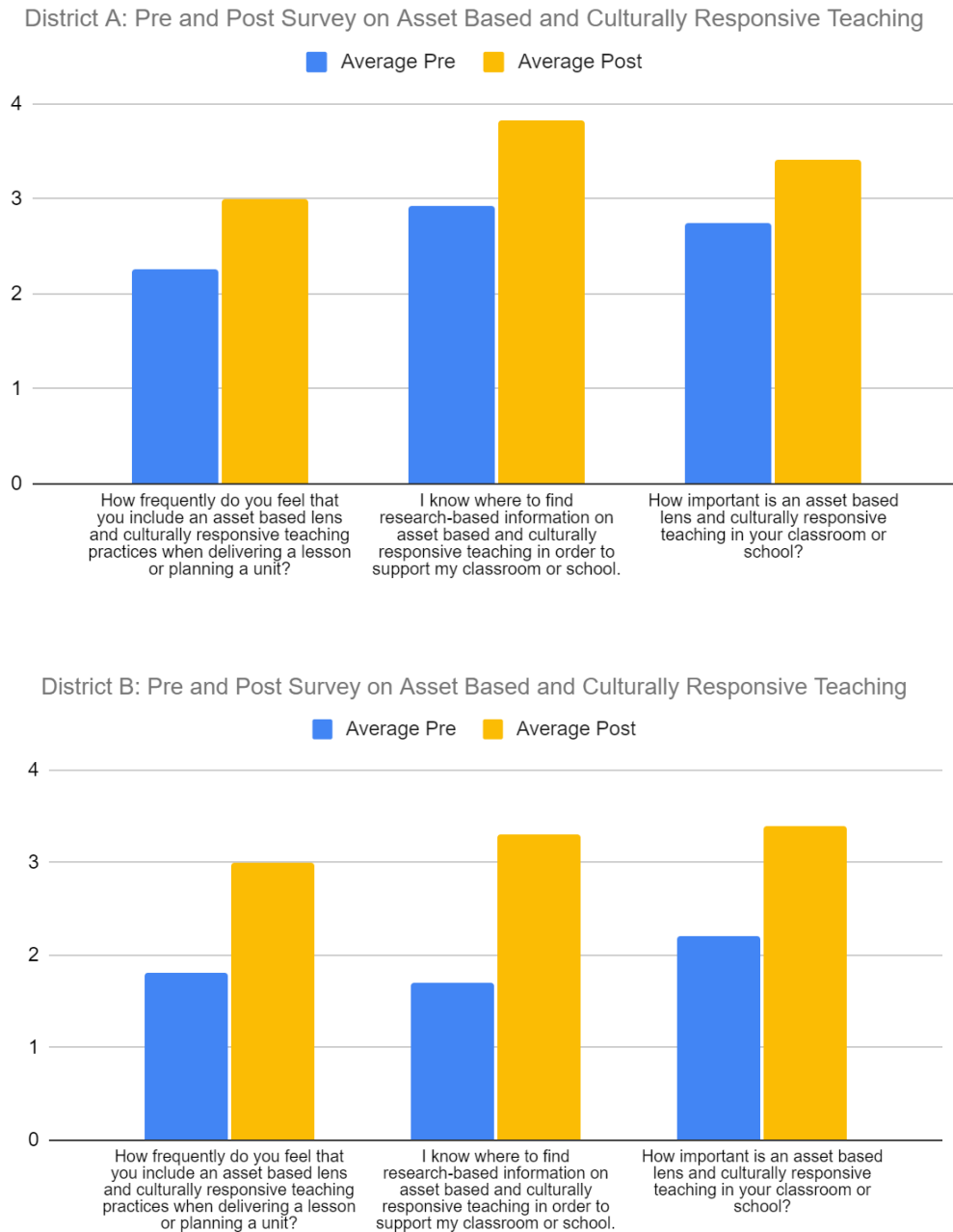
When asked how often asset-based learning takes place in their classrooms, District A's pre survey responses averaged 2.25 while District B's average response was 1.8. Prior to this study, participating teachers from District A had completed a book study utilizing *Culturally Responsive Teaching and the Brain* by Zaretta Hammond and made intentional steps to working toward an asset-based learning environment. Their responses were most likely rated higher from already being introduced to Culturally Responsive Teaching. The remaining questions addressed if teachers knew where to find resources, implementing lessons, and the importance of asset-based learning in each classroom environment. Distinct A showed a larger confidence throughout each response and District B maintained a lower response. However, all teachers, no matter the level of confidence, identified that assed-based and UDL was important to incorporate in their classroom environment. Even though teachers in both districts were on different levels of understanding, the responses led the researchers to develop a professional development that was centered around the needs and understanding of each teacher in their respective district.

The survey also included open ended questions that were centered on what teachers initially defined as asset-based teaching before the PD sessions. In District A, 4 out of 5 (80%) participants were able to define asset-based learning while none of the participants in District B were able to define the meaning. Although there is a disparity in the ability to define asset-based learning in the two districts, both noted the willingness to expand their learning and an openness to then incorporate it in their classrooms.

Both researchers worked with their respective teachers to guide them through a PD session on Culturally Responsive Teaching that incorporated asset-based learning and UDL. During individual coaching sessions, ITFs intentionally utilized technology to engage

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students along with working with the classroom teacher on the curriculum direction. Students were invited to participate in their learning by being given choice and student voice in their learning. Throughout the coaching process, both researchers highlighted the importance of asset-based learning and UDL throughout the planning and implementation of each lesson. At the conclusion of the coaching sessions and lesson delivery, all teacher participants were given the same asset-based learning survey as a post survey as noted in Figure 3. Both districts demonstrated growth in their learning about asset-based teaching as well as creating a more well-defined understanding of how to incorporate this into their classroom. In District A, teachers showed growth in all the areas for the Likert scale questions, however, growth was 0.8 points average while District B showed an average growth of 1.2. (Refer to Figure 3) The growth rates demonstrate growing in their knowledge of asset-based learning and UDL. District A had already established background knowledge on the content, so their growth was not as drastic as District B, where this information was all new knowledge. Teachers in District A described Culturally Responsive Teaching as an intentional integration of students' culture and assets as well as implicit biases a teacher has. Teachers in District B acknowledged the need to be inclusive of student needs and recognizing the importance of asset-based teaching versus deficit-based teaching.

Creating Learning Partnerships in the Classroom Environment

The third research question explored the ways a meaningful learning partnership can be cultivated between an instructional technology coach, teacher, and student by collaboratively developing a lesson that centers students' voice and choice. Data collected to address this specific question was the Coaching Work Plan (Appendix C), which each ITF maintained with each teacher. Student and teacher focus groups were conducted at the end of

the unit to provide an in depth look into the effects of the paradigm shift and how that impacted student learning. During each coaching session, the ITF and classroom teacher met to discuss the curriculum that needed to be taught and how technology could engage student learning along with ensuring students were seen with an asset-based lens. Throughout the planning process and implementation of the lesson, the ITF offered the teacher support. At the conclusion of the lesson, every participant commented how the lesson would not have been successful without the support of the ITF. One teacher from each district had prior knowledge of the technology tool they wanted to use from prior professional development, however, had not implemented it due to the teacher not feeling confident in being able to do it alone. Both teachers commented that the lesson would have been overwhelming or not successfully completed if it were not for the ITF's support.

At the conclusion of the lesson, a student focus group from each district was organized and students were able to share their thoughts about the lesson. Students were excited to share their thoughts about the lesson, using technology, and their thoughts on how to continue to improve instruction with technology integration and students voice and choice. Students in both districts referenced having choice enhanced the lesson and their engagement.

Creating a Gender-Neutral Learning Environment

Each classroom environment can offer opportunities for students to learn or introduce barriers to their learning. Throughout the author's study intentional focus was given to creating spaces for all students to feel supported in their learning through asset-based pedagogy supported by the ITF. Creating a learning partnership between teachers and

students requires each teacher to understand how each student learns, how they think, and how they perceive themselves.

When addressing gender inequality in STEM curriculum, it is important for teachers to understand how their female students perceive themselves in the STEM learning environment. During a science lesson in District B intentional consideration was made in preparing the lesson for students. The lesson featured two female educators both in the STEM field along with female role models throughout the lesson in the STEM field as well. During the lesson one female student commented, "I can see myself being successful because both of you are girls and you are doing it!" Student perception can be powerful when addressing how to create a gender-neutral learning environment. Creating spaces for students to see themselves reflected in STEM roles can make the learning environment more inviting and less intimidating.

Throughout the study, the researcher saw no overt examples of female students being excluded in STEM learning. Since all participating elementary teachers as well as the researchers identify as female and Feminist Theory was utilized as a framework to guide the coach's work, lessons included advocacy for women and girls in the STEM curriculum. Facilitating the study through the lens of a feminist author created intentionality to offering STEM as a gender-neutral opportunity. Although there was no evidence of overt exclusions for girls in STEM lessons, there remained no evidence of females being highlighted either. Exploring ways to go beyond female role models and instructors can enhance the motivation for girls to participate in STEM curriculum opportunities in a more intentional way.

Results

After reviewing all the data collected from surveys, focus groups, coaching work plans, and field notes, three emerging themes come to the surface. The three themes from the data were the importance of the ITF role in coaching and co-teaching, the engaging ability of technology integrated into the curriculum, and the need for asset-based learning through Culturally Responsive Pedagogy in the classroom.

Importance of the ITF Role in Coaching and Co-Teaching

The role of the ITF proved to be critical for the intentional integration of technology in the classroom. Several teachers noted that without that support they wouldn't have felt comfortable trying a new technology tool with their students. One participant stated, "I was excited to have the extra support in the classroom. I often try lessons using technology and something goes wrong, and I can't remember what to try from the previous PD." Both districts have a different model for the ITF position. In District A, the ITF supports 2 schools with approximately 670 students while the ITF in District B supports 10 schools with approximately 6,384 students. During the initial survey, participants in both districts were asked to identify how often they utilize the ITF for instructional and technical support with once a week, once a month, once a quarter, once a year, or not at all (Figure 4).

Figure 4

Frequency the Instructional Technology Facilitator Utilized for Instructional Support for
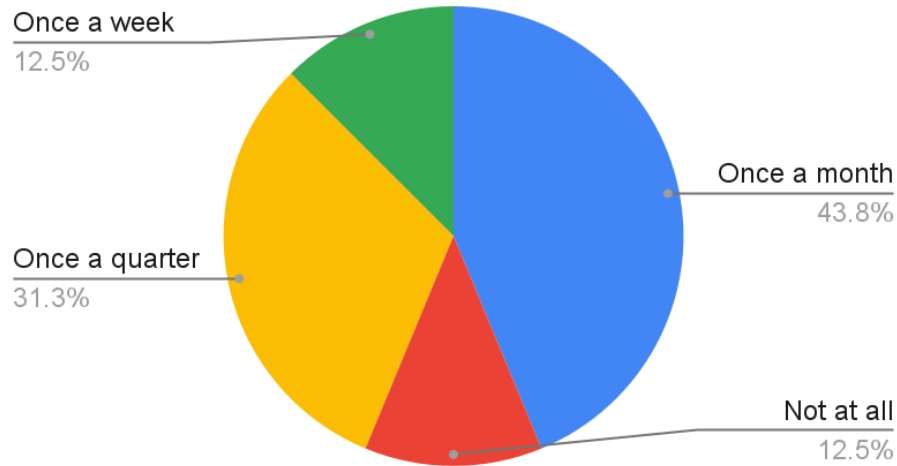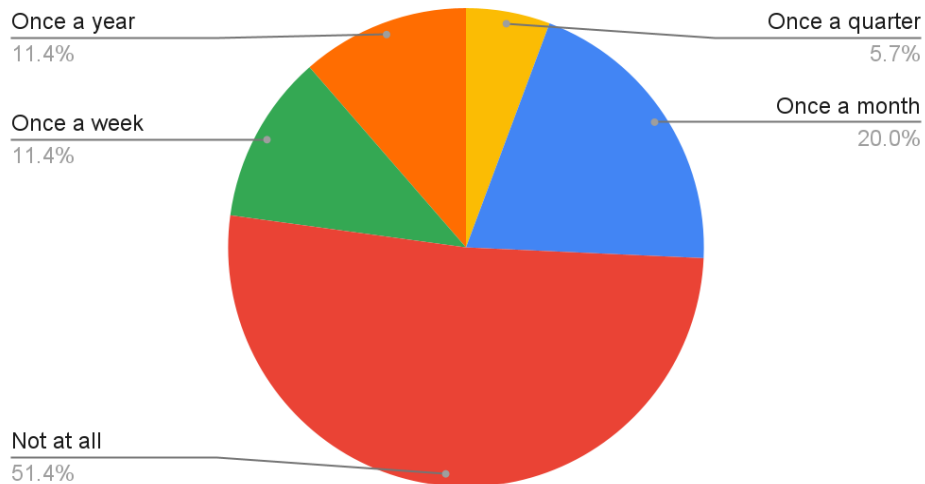
District A and District B

Due to the fact that the District A ITF is able to serve a smaller population of students

and schools as compared to the District B ITF, by reviewing Figure 4, it is clear that District

A utilizes the ITF instructional support at a higher frequency.

Engaging Ability of Technology Integration

When interviewing both teachers and students there was an overwhelming number of comments from both focus groups on how technology brought excitement to the lesson and was engaging. Technology has a way of being an engaging hook for students to get excited about their learning. As digital natives, technology is also a tool that is familiar to most students, so they have a comfort level in using it to guide their learning. Used with intentionality, technology can offer a way for students to become 21st century learners who communicate, collaborate, create, and critically think.

The Need for Asset-Based Learning Through Culturally Responsive Pedagogy

Finally, the need for Culturally Responsive Teaching in schools became evident throughout the time the researchers worked with classroom teachers. Prior to co-teaching planning and lessons, teachers in District A had a general understanding of asset-based learning while District B were learning it as a new skill. In both districts, their knowledge for asset-based learning and Culturally Responsive Teaching was found to be beneficial by incorporating student voice and choice in the lesson. When considering how to be more inclusive for all student learners with the use of instructional technology and in STEM education, Culturally Responsive Teaching is a great way to purposely consider all students in the classroom and ensure that learning is addressing all their specific needs.

Discussions

When creating gender neutral, inclusive classrooms, especially when incorporating STEM skills, Culturally Responsive Teaching can address, not only including female students, but all students and their learning needs. The author's theoretical framework is Feminist theory, which offers insight into the inequity of female student participation,

however, it should not be limited to only cisgender female populations. After reviewing the data, it is apparent that through culturally responsive pedagogy, students who are traditionally marginalized need to be included in their learning and the learning environment. As stated earlier, gender has been inequitable in STEM education, however, so has ethnicity and race. At the conclusion of this study, the author realized that to be truly utilizing an asset-based framework in Culturally Responsive Teaching, there is more to consider than just a student's gender. For the STEM educational environment and curriculum to become inclusive to all students, utilizing asset-based pedagogy, Culturally Responsive Teaching, and UDL can begin to bridge the gap for historically marginalized students.

Conclusions

This article was a collaborative study to investigate how technology can be effectively integrated in the classroom to offer an equitable STEM learning experience for all students. Saucerman & Vasquez (2014) found, "Parents, educators, and employers can begin to untangle the effects of expectations on girls' and women's performance by identifying the factors that contribute to the ongoing underrepresentation of women in STEM and by making the corresponding modifications in behavior" (p. 60). In the author's research, female participation in STEM educational opportunities and roles were identified as an area for growth. However, through the collaborative study, the author realized that female students were not the only inequity in the classroom environment. Untangling these effects can be beneficial to gender, ethnicity, race, socioeconomic class, and other marginalized groups of students by using Culturally Responsive Teaching. This paradigm shift is not one that can happen over a short period of time and will take intentionality and purpose. However,

utilizing roles such as a school or district ITF can begin to start the needed change in schools themselves.

Limitations and Future Directions

The focus of this article is on addressing the gender gap in STEM education. The use of female in this article is a cisgender reference. The author recognizes that more exploration can be done in including all students that identify as female. The goal is for an inclusive classroom environment that doesn't exclude any student from STEM opportunities or roles. Further research into how to provide a more inclusive classroom would include looking at the data with a Critical Race Theory lens and work in Culturally Responsive Teaching pedagogical practices.

The study included elementary teachers who are predominantly female. The results obtained in this study may not be applicable if conducted in an elementary environment that included a greater percentage of male teachers. As pointed out in the gaps in the literature, there is a need for more robust studies conducted in elementary STEM classrooms.

Future work in the area of asset-based pedagogy, learning partnerships, and female representation in STEM fields continues to be a passion and area of work the author actively continues to push for change.

Deep Reflection: Two Lenses and their Intersectionality

"Education is a vehicle to self-realization and freedom." (Aguilar, 2020, p. 6)

The doctoral program at Appalachian State University does not create leaders, but rather, it shapes educational leaders through a process that allows students to see themselves fully, confirm their values, and name disparities that have existed all along. Through our different lenses, we were able to find the intersectionality of our work and interests in empowering students as Instructional Technology Facilitators by coming together through this collaborative dissertation. Our passion for quality and equitable public education as a right for every student guided our work and helped us refine our leadership skills. Our doctoral journey helped us refine our leadership and research skills in order to continue to support educators and students.

As we reflect on our work, we are reminded of the quote we used in our first chapter by Wheatley (2008), where she defined, "a leader is anyone willing to help, anyone who sees something that needs to change and takes the first steps to influence that situation" (p. 1-2). Our dissertation work has been centered around the need for equitable representation in the classroom. Through our coaching roles, we had the opportunity to lead teachers in understanding how an asset-based lesson with technology richly integrated into the curriculum could transform the way students participated, engaged, and interacted, not only with their content, but also in learning partnerships with their teacher and peers.

Purpose of Our Work

At the beginning of the doctoral program, we were tasked with learning about theories and organizations through leadership while paying particular attention to ideas that came to the surface for us. Together, we share a passion for integrating technology along with making sure all students can participate in their learning environment. Our work was always centered around integrating technology as Instructional Technology Facilitators, however, we both found that by using theoretical frameworks, we could create technology integration in an equitable way. Critical race theory and feminist theory became the lens we each looked through when evaluating and designing how technology could be integrated into classroom curriculum.

We both shared similar background experiences, which included feeling like our choices in careers were limited. Though we both started as K-5 classroom teachers, later in our career we discovered a love for technology and supporting others. We have both reflected on how technology was not introduced to us or even a choice during our own K-12 learning experience. We both wanted to create a space for all students, especially female students and historically marginalized students to know all the possibilities and choices they had in their education.

In our roles as coaches, we also realized that we have had to navigate what it means to coach educators and administrators. The transition from classroom teacher to school or district leader required a steep learning curve that was not always easy. As coaches, we recognized the power we wield by influencing educators and leaders with pedagogical choices they must make. As famously stated in the Spiderman comics, "with great power comes great responsibility," and we recognized that our choices could empower or hinder

learners and teachers. Through our passion for teaching students, technology integration, and creating a positive change in education, we found that our dissertation work could be utilized to address the changes needed in our K-12 educational spaces for all students.

Results From Our Study

Though our conversations, it was easy to determine the themes that came to the surface based on our data. In considering our perspectives and our roles, Table 6 demonstrates our takeaways with a more in-depth analysis explained below.

Table 6

Implications of our study

1. An ITF's critical lens plays a significant role in the intentional integration of equitable instructional technology.
2. Technology is engaging and can be a way to "level the playing field."
3. Instructional technology and pedagogy are not inherently neutral and can perpetuate disparities.
4. Unlearning rigid and inequitable pedagogy takes time and intentional coaching.
5. Coaches require professional development to ensure they are critically evaluating inequitable practices and are culturally responsive coaches

An ITF's Critical Lens Plays a Significant Role on Equitable Instructional Technology

Utilizing Critical Race Theory in our coaching and when evaluating our field notes confirmed how important it is to have conversations around race and ethnicity. Asking who is being left out of the lesson and noting their identity helps us ask why. The societal expectation that technology is 'good' and race neutral can be problematic if the educator continues to utilize it in a way that centers whiteness or is used as an exclusionary practice.

Instructional technology, when centering student strengths, assets, and considering their collective versus individualistic approach to learning, can be an empowering tool. Switching from writing an essay to typing an essay on a device does not mean it will automatically 'level the playing field' in the classroom. Though it may be more engaging or provide a different way to produce writing, students still require access to learn how to use annotation tools, speech-to-text tools, translation functionality, or other ways to represent their thinking by using instructional technology. This requires recognizing a student's strengths, their cultural lens, and a "warm demander" approach for all students, regardless of their racial or ethnic identity (Hammond, 2015). Hammond describes a 'warm demander' as an educator that understands the emotional support a student requires, but still holding that student to high academic expectations. An ITF is a crucial piece that must regard these dynamics in order to dismantle the engrained pedagogy that has been historically centered on whiteness.

The ITF can also play a critical role in advocating for female participation and inclusion in the STEM classroom environment. As we continue to grapple with how to create a more equitable learning environment, our study can be used to propel the work in the technology field to highlight the importance of female representation. There are many remarkable women in the technology and science fields, however, creating change takes time and consistent attention. Academy Award-Winning Geena Davis is an advocate for women in breaking down the gender biases that exist. She summed up how to address the gender gap eloquently by stating, "If she sees it, she can be it." As we continue our work in educational technology, we want to allow female students to see they can be successful in any STEM field no matter their gender.

Technology is Engaging and Can "Level the Playing Field"

Through our intersectional lenses, we were able to determine that instructional technology can be an incredible hook to engage students into the curriculum, but must be introduced with intentionality. It is important to note how technology can help make the brain curious about the content and it is important that teachers provide the appropriate scaffolding necessary to ensure that students all have access to these engaging tools. Technology tools should not be limited to high flyers because of the ease with which it would be to keep those students busy with a technology-enriched activity. Instructional technology, when implemented with intentionality, can eliminate barriers that may have limited students otherwise. For example, when students were tasked with completing their podcasting drafts in a Google Doc template, all students were actively working, and the teacher noted how the Chromebook 'leveled the playing field' for her students. At first glance, it may seem as though the Chromebook itself kept all students engaged, but it is important to dig deeper into the details of how this lesson came to fruition. A teacher and coach will notice that a student with orthographic challenges was able to use speech-to-text, with prior skill building to utilize this tool was provided, while their peer was typing away. The Google Doc was also set up with specific parameters that enabled students to focus their cognitive load on the content rather than troubleshooting the format. Finally, students were invested in the outcome of recording their podcast episode on something they selected and were personally interested in sharing. Noting the specific details of this instance allows educators and coaches to see that providing the technology itself will not 'level the playing field,' but it can be a tool that can be leveraged for engagement and investment in the learning.

Instructional Technology and Pedagogy Are Not Inherently Neutral

Acknowledging instructional technology as another structure that can incorporate societal bias or preference depending on the critical lens, or lack thereof, of an educational leader is a crucial step in understanding how these tools are not inherently neutral. As educational leaders, it is important that we remember that instructional technology will not be the 'silver bullet' to repair years of historical marginalization that have left women and BIPOC students behind. Instructional technology tools are created and implemented by humans that carry their own implicit biases on who these tools are for. Though it has been a goal for teachers to be 'colorblind' when they see their students, dismissing a student's culture in order to assimilate, does not make a classroom neutral, but rather monocultural and lead by the classroom teacher's lens. When leaders can recognize that instructional technology tools can be leveraged to lift up and give voice to those that have been historically disregarded, especially in the field of computer science or STEM opportunities, then we can examine our own pedagogical practices that can perpetuate these harmful stereotypes.

Pedagogical Shifts Take Time

Shift in pedagogy takes time and intentionality. Throughout our co-teaching work, we found that small changes in pedagogical thinking were occurring. All teachers that participated in co-teaching attended professional development on Culturally Responsive Teaching through an asset-based lens. Distinct A had previous learning opportunities on the subject while this was all new learning for District B. At the conclusion of our work, both districts grew in their knowledge and understanding of creating an equitable learning environment for their students. We found that teachers were beginning to correct themselves

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when discussing students or lessons when it did not align to what they had learned through our PD sessions. As described within the field notes, Nava Eggett noted, "As we were talking, at first she wanted her highflyers to create a video explaining the evidence organizer, but she caught herself because that would mean not everyone would get a chance to use a technology tool." Burry noted, "Our conversations about students changed to a conversation for students. This small shift in not focusing on what students could not do changed to highlight ways students were successful and how the curriculum could meet them where they are." Even though these changes were small, they were a move in the right direction. Our work was a representation of how changes could be made and the continuation of what we started will make an intentional shift needed in both of our districts and classrooms.

Although we used the same data sets through our distinct theoretical frameworks, we were not sure what our final results would look like. Learning more about what educators and leaders thought about our role as an Instructional Technology Facilitator, while seeing how we are utilized, was the biggest takeaway. Though we understood how different our roles are in our respective districts, uncovering what it means for others confirmed our thoughts: having a full-time ITF in one building helps teachers integrate technology in a more meaningful way. The current state allotment for ITF positions per district is not able to meet the demands of teacher coaching and support. District A can provide more ITFs solely because the district has chosen to utilize local funds and has prioritized these positions in the district. It was clear that District A teachers were able to have more access to the ITF in order to support their co-teaching or coaching needs rather than primarily depend on the ITF for technical support as they do in District B.

Due to the explicit need for coaching that was required by this research, it was hard to determine the reality of scheduling coaching in District B versus District A. Though it was clear that intentional coaching in both districts allowed for individual growth and understanding on centering students, the ITF in District B does not have an opportunity to do that as frequently as the ITF in District A due to the difference in the number of schools they must support.

We also learned the value of co-teaching with our teachers versus providing a general professional development on a tool or instructional strategy. Co-teaching allowed us the opportunity to create a trusting relationship with our co-teachers which provided us time to collaboratively work one-on-one to make a shift in lesson design together rather than in isolation. Through our co-teaching opportunities, we found that teachers felt more comfortable discussing ways in which to rethink their instruction, but in a safe environment. Utilizing a feminist approach in our learning partnerships with our co-teachers, which actively seeks to support and care for others, was key.

There are different ways the ITF can provide support and oftentimes we are asked to provide professional development to all teachers in a general way. This is helpful when there is a new tool everyone is expected to use per the school, district, or state. Unfortunately, this does not always mean our teachers will go back to the classroom to try out these new tools or skills. Co-teaching with intentional meeting times and opportunities for reflection allowed our teachers to see how this tool played out in their classroom with their students. The ITF became a 'safety net' of support as students and teachers alike tried out a new tool and pedagogical strategy. Especially during another stressful school year, it is important for the ITF to be available for demonstration, support, and troubleshooting as they offer another

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perspective to how the lesson played out. Teachers in both districts discussed the value of having the ITF co-teach in order to ensure that the lesson or unit was completed successfully. One teacher had described needing our coaching meetings as a gentle push to finish. Having an ITF as an accountability buddy certainly helped ensure that teachers tried something new, especially to hook in their disengaged students. An ITF's lens and understanding of how students can be left out, whether it be due to a language barrier, a teacher's bias, or a student's exceptional need, is important if educational leaders want to continue to use instructional technology in an effective way.

Critical Self-Reflection and Support for Culturally Responsive Coaches

Our collaborative research also taught us how critical the ITF's role is in making sure all students have equitable access to instructional technology and are being seen with an asset-based lens. An ITF can have an incredibly positive or negative impact on the teachers they are supporting, depending on how they approach their coaching. Critical self-reflection, anti-racist education, and targeted professional development on coaching are needed to support ITFs as they support others.

It is crucial that coaches make the shift to being culturally responsive coaches. We recognized that there was a lot of research surrounding culturally responsive teaching, but explicit work around what it means to be a culturally responsive coach is still necessary. Being a culturally responsive coach requires being gender and queer inclusive, anti-racist, and can demonstrate equitable practices in their own coaching moves. Many ITFs are hired into a coaching role with no experience as a coach and no support on what this really looks like. Ensuring that instructional coaches and educational leaders are given opportunities to consider their role and its impact on staff and students are important, which we had not

thought about deeply before this collaboration. Speaking through our experiences, we have been able to name the support we needed as culturally responsive coaches. This prompted us to have conversations with our respective directors on what book clubs or professional development could be provided or developed in order to ensure we are on the same page as well as delivering on our promise of equitable education through instructional technology.

Beyond Our Dissertation Work

As we conclude our dissertation work together, our journey of growth and leadership will continue. First and foremost, the doctoral program and our collaborative dissertation has brought us together professionally. When we started our concentration work in Instructional Technology Leadership in 2018, we both shared a passion for instructional technology and ways to create integrated education in our workplaces. From our scholarly passion, we worked together on how to be leaders in our field. Throughout our work, we discovered that equality and equity in technology use in the classroom became a focal point. With our distinct lens of Critical Race Theory and Feminist Theory, we will push for thoughtful technology integration into the classroom curriculum to ensure the inclusion of traditionally marginalized students through these tools. Having a better understanding of the impact of the ITF role, as well as the continued disparities that exist in schools, guide our next steps in our districts. How do we leverage our positions to ensure that coaches know their impact? How do we help other coaches like ourselves understand their own biases and need for intentional learning in order to remove barriers that we may be perpetuating as leaders? How can we reduce the harm that our students of color, LGBTQIA+, and female students experience in classrooms and schools? Our dissertation work may be completed, but our need to support

others by shedding light on how schools can empower our students and see those that have been underserved be centered through an asset-based lens continues.

Our professional relationship with one another has also helped us broaden our understanding of our roles, especially since we work in distinct communities. Not only has our work with one another strengthened our ability to collaborate and communicate with others, but helped us make more connections to expand our own Personal Learning Network (PLN). Our use of technology to connect from a distance has also shown others how meaningful learning communities can be cultivated through technology. This completion of our work is a testament to how work can be accomplished, and relationships be built without being face-to-face. We hope to not only be an example for future collaborative dissertations, but also highlight the beauty of instructional technology and remote learning to further our thinking, deepen our connections with others, and share our learning.

Finally, our main purpose for seeking our doctorate was to help others learn from our work. By creating a series of articles that we intend to publish, we hope that our work can offer insight into how our role as educational leaders should be used to leverage resources in order to eliminate barriers. Districts across the country are pumping money into technology tools for classrooms, but may not be considering all aspects of what it takes to make sure those tools are used equitably, responsibly, and frequently. Purchasing technology is now a needed expense that should not be taken lightly, nor should it be assumed that it will fix existing disparities. Having trained instructional technology facilitators that are aware of inequities and their role in leveraging those tools for all students is a key piece to support teachers and students in the classroom. These ITFs should be available in each school with the ability to be a part of the school culture in order to make the biggest impact on classroom

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support. We hope that our work can be used as an example of best practice, and we will

continue to strive to make learning environments the most inclusive and welcoming spaces

for all.

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DIGITAL TEACHING & LEARNING

About the NC Digital Learning Competencies for Classroom Teachers

The teaching and learning process is a complex balance of content knowledge, pedagogical strategies, and technological resources. The following Digital Competencies, informed by International Society for Technology in Education (ISTE), International Association for K-12 Online Learning (iNACOL), and the NC Professional Teaching Standards, are to be viewed within the context of the current North Carolina Professional Teaching Standards as extensions in relationship with the ways that digital technologies impact and affect schools.

Teachers and administrators should use these competencies to improve their practice and drive student learning within their classrooms. The following four Focus Areas have been loosely aligned to the Professional Teaching Standards with a subset of competencies that help to explain and 'unpack' the Focus Area.

Leadership in Digital Learning
Teachers will demonstrate leadership in accelerating their integration of digital teaching and learning pedagogies.
Engage in virtual and face-to-face learning communities to expand mastery of technological applications for professional growth and student learning.
Take initiative with own professional growth to inform practice.
Demonstrate leadership for technology innovation beyond my own classroom.
Engage in peer collaborative problem solving through continuous planning, designing, testing, evaluation, and recalibration of teaching methods using appropriate digital technology.
Promote open, lifelong learning as an iterative process of success, failure, grit, and perseverance.

Digital Citizenship
Teachers will model and teach digital citizenship by the ethical, respectful, and safe use of digital tools and resources that support the creation of a positive digital school culture.
Demonstrate understanding of intellectual property rights by abiding by copyright law, intellectual property, and fair use guidelines.
Teach and require the use of copyright law and fair use in student work and creation.
Engage in responsible and professional digital social interaction.
Integrate digital citizenship curriculum into student learning.
Demonstrate global awareness through engaging with other cultures via advanced communication and collaboration tools.
Ensure full, equitable access and participation of all learners through high-quality technology tools and resources.

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DIGITAL TEACHING & LEARNING

Digital Content and Instruction

Teachers will know and use appropriate digital tools and resources for instruction.

Design technology-enriched learning experiences that encourage all students to pursue their individual interests, preferences, and differences.
Lead all students in becoming active participants in setting educational goals, managing learning, and assessing their progress through digital tools.
Identify, evaluate, and utilize appropriate digital tools and resources to challenge students to create, think critically, solve problems, establish reliability, communicate their ideas, collaborate effectively.
Immerse students in exploring relevant issues and analyze authentic problems through digital tools and resources.
Evaluate and appropriately modify the form and function of the physical learning environment to create a conducive digital learning environment.

Data and Assessment

Teachers will use technology to make data more accessible, adjust instruction to better meet the needs of a diverse learner population, and reflect upon their practice through the consistent, effective use of assessment.

Integrate digitally enhanced formative and summative assessments as a part of the teaching and learning process.
Use performance data and digital tools to empower student metacognition for self-assessment & self-monitoring their own learning progress.
Utilize multiple and varied forms of assessment including examples of student work products.
Utilize technology and digital tools to synthesize and apply qualitative and quantitative data to: • Create individual learner profiles of strengths, weaknesses, interests, skills, gaps, preferences. • Inform, personalize, and calibrate individual learning experiences. • Identify specific plans of action related to weaknesses, gaps, and needed skills as identified in the learner profile. • Reflect and improve upon instructional practice.

2

Appendix B

Sample of open-ended responses from perception of ITF role survey, Fall 2021

Question	Example Quotes from open ended responses
In one sentence, share what you know about the role of the Instructional Technology Facilitator.	"The ITF role involves coaching our teachers so that they know how to most effectively use tech for their students' learning and for their practice as an educator." "I believe the role is to maximize the efficacy of digital tools for learning and instruction, while empowering teachers to also use technology for the best use of data." "The ITF works closely with teachers to look at their curriculum to see where digital technologies would be most appropriate for content, goals, and student improvement."
What do you know about STEM?	"It's the integration of science, math, tech and engineering into all the curriculums to create more opportunities for students to use STEM skills to access their studies." "Hands-on learning in science, technology, engineering, and mathematics that digs deeper into student learning on the standards" "Teaches students problem solving skills and creates innovative thinking and learning"
What is the role of the Instructional Technology Facilitator in supporting teachers as they use technology to facilitate equitable representation in STEM, both in opportunities and future career pathways?	"The ITF should help the teacher in locating and developing resources to support STEM instruction. Teachers need more PD to instruct students with regard to the state's student technology standards requirements. This instruction should support teachers in providing opportunities, diversity, and equality in showcasing both male and female students' aptitude towards math and science and future career pathways." "Instructional Technology Coaches can be effective in not only offering PD which draws attention to disparities in education and the stem career field, providing opportunities which support equity, and presenting opportunities for increased visibility of diverse figures." "The ITF models the use of an equity lens when working with students and teachers in STEM." "Their role is to expose students to a variety of different tools to facilitate engaging experiences to support their interest/understanding of STEM concepts. "

COACHING WORK PLAN
2021-2022

"A coach is not necessarily an expert who trains others in a way of doing something; a coach helps build the capacity of others by facilitating their learning."

Dena Aguilar, The Art of Coaching

Teacher/Grade:
Instructional Technology Coach:

Goal Alignment		
North Carolina Digital Learning Standards for Students and NC Standard Course of Study		
NC DLS for Students	☐ Empowered Learner ☐ Digital Citizen ☐ Knowledge Constructor ☐ Innovative Designer	☐ Computational Thinker ☐ Creative Communicator ☐ Global Collaborator
NC Standard(s) for:		

SMARTE Goal 1 *(Is it Specific, Measurable, Attainable, Relevant, Timely and Equitable?)*

Rationale

Strategic Activities	
Teacher and coach together *(collaborative planning)*	
Teacher *(implement lessons, reflect)*	

Students (*student voice, autonomy, activities*)	
Coach (*model, observe, reflect, provide resources*)	
Indicators of Progress (*list potential indicators, and list actual evidence as identified*)	
Sept 22	
Summary/Reflection Field Notes Reminder (*to be completed for the researcher separately; do not complete here*)	

Appendix D

Co-teaching lessons that centered student choice and voice

Lesson/Unit	Examples of culturally responsive UDL in this lesson
Podcasting to build community	• Students selected partners • Students chose their topic to write and record about (ie things they are successful at outside of school, their race or gender identity, their neighborhood, or a time they overcame something challenging) • Students were able to comment on each other's recordings
Stop motion leadership videos	• Students identified their strengths on color coded cards (ie organizer, scriptwriter, video recorder, or props) • Students created groups based on each card being represented in the group • Students had creative autonomy of their video as long as it focused on a leadership skill provided by the teacher • Students will be able to present their stop motion videos to the school community
Centering Native American authors	• Students were presented with different Native American authors each week for four weeks to center Native American voices and their experiences • Students selected center activities that allowed for a Flipgrid recording, a written or drawn response to add to a collaborative mural, a message for the map, or a favorite book drawing
Green screen historical figure recording	• Students selected a historical figure of their choice (regardless of their own racial or gender identity) • Students created a prop and decided what their "costume" would look like • Students completed a self-evaluation on their progress and goals • Students created their background illustration for the green screen • Students created their 1 minute speech for their green screen recording
Adobe Spark Page or Flipgrid Evidence Organizer	• Students responded to a survey that gave the teacher feedback on their technology tools they would like to learn how to use • Students were able to choose from the top two choices: Flipgrid or Adobe Spark Page • Students self-selected a non-fiction text to complete their evidence organizer • Students had creative control over their visuals for their presentation using Flipgrid or Adobe Spark Page • Students presented their work to one another and were able to ask questions

Designing 3D Moon Rovers	• Students designed moon rovers to explore and collect samples from the moon's surface • Utilizing prior learning on the moon's surface, students had to take their learning and translate it into their design. • Students used the engineering design process throughout their design process • Models were created in Tinkercad and each student received a 3D model of their moon rover design
Shapes with Apple Clips	• Students reviewed their knowledge of shapes by going on a shape walk throughout the school • Students took pictures of 2D and 3D shapes around their school building • Pictures were then used to create a clip in Apple Clips to display their knowledge and understanding • Students labeled shapes and identified properties about each
Landforms Choice Board	• Students were learning about landforms and salt/fresh water • To change up their learning students were given a choice of activities to participate in which included videos, learning games, and readings. • At the conclusion of the activity, students were asked to brainstorm other lessons where choice boards could be used to enhance their learning
Climate and Weather	• Students learned about weather and climate with their choice of learning by reading informational texts, videos, and/or infographics. • Students reviewed their learning through problem solving with real world problems in a breakout box
Reinventing the Technology Rotation	• Students wanted to reinvent their weekly technology rotation to include an interactive activity • Using Apple Classroom students were able to complete an activity on the blends they were learning by taking a picture of the blend card, recording themselves reading the word, and labeling each with the name of the picture which included the blend

Vita

Rebecca Hannon Burry was born in Spartanburg, South Carolina to Mike and Arnette Hannon. She graduated from the University of South Carolina in May 2005. The following fall, she excepted a teaching position as a third-grade teacher and continued teaching at the elementary level for the next nine years in South Carolina, Tennessee, and North Carolina. In the fall of 2012, she entered Appalachian State University to study a Master of Arts degree in Instructional Technology, Computers. Upon her completion of this degree in 2014 she became an Instructional Technology STEM teacher for the elementary level for eight years. In 2018, she commenced work toward her Ed.D. in Educational Leadership in Instructional Technology at Appalachian State University and completed this degree in May 2022. Recently, she accepted a position as a Digital Teaching and Learning Coach in Iredell-Statesville Schools.

Kimberly Ann Nava Eggett was born in Los Angeles, California and relocated to Asheville, North Carolina at the age of eight. As a North Carolina Teaching Fellow, she graduated summa cum laude from UNC-Asheville in 2005 with a distinction in Spanish (B.A.) and received her licensure in K-6 Elementary Education and K-12 Spanish Education. In 2006, she began her elementary education teaching profession as a 4th grade and 5th grade teacher in Asheville City Schools. After six years as a classroom teacher, in 2012, she transitioned to being an Instructional Technology Facilitator/Digital Lead Teacher after completing her Master of Arts degree in Educational Media/Instructional Technology from Appalachian State University. She has served as the co-chair and founder of her school's social justice committee and launched their racial equity work from 2014-2021. In the fall of 2018, 2019, and 2021, she served as an adjunct professor at UNC-Asheville to teach the

course, *Facilitating Global Citizenship: Teaching Critical Thinking in the Social Studies, K-6,* to preservice teachers. In 2022, Nava Eggett was recognized as the NCTIES Impact Award recipient and completed her Ed.D. in Educational Leadership in Instructional Technology at Appalachian State University.