STEM EDUCATION AND SOCIAL ISSUES: PERCEPTIONS AND PEDAGOGY

By

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Abstract

The number of jobs in STEM (science, engineering, math, and technology) fields increased 16 percent from 14.2 million in 2004 to 16.5 million jobs in 2012 (Government Accountability Office [GAO], 2014). Students at STEM-based higher education institutions research ways to build and improve infrastructure, study methods to face climate change, create algorithms to improve day-to-day efficiency, and design apps that benefit our lives and ones that provide solutions to problems we face as a society. However, STEM institutions are generally not known for their emphasis on addressing social issues. Often students do not enroll in STEM institutions to learn about issues that affect our national and global communities. Garibay (2015) found that STEM students who seek to become engineers, computer scientists, and scientific researchers have low levels of social awareness and view the importance of working for social change as less important to their career goals. In addition, students who spent time as a STEM major are more likely to show signs of lower social awareness at the end of college, and majoring in a STEM field has a negative relationship with student understanding of diverse global communities.

An intervention module that focused on social issues and social inequity was used to investigate student beliefs of the social issues and social inequity topics. Further, the study examined to what extent a redesigned STS (Science, Technology and Society) course at the New Jersey Institute of Technology influenced student perceptions of social issues and how their work can potentially be seen as a catalyst for social change. Student written responses, a researcher reflective interview, a questionnaire, and a focus group were used in this qualitative action research study.

Keywords: STEM, STEM education, social issues, social responsibility, pedagogy, perceptions

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Chapter 1: Introduction to the Study

There is a growing discussion that suggests students who take part in the STEM curriculum often have limited exposure to coursework in fields outside of STEM, and are often less aware of social justice issues and social inequity that are present in society than their non-STEM peers. In 2015, Garibay used a national sample of 6,100 undergraduates through the "Cooperative Institutional Research Program's (CIRP) Freshman Survey and College Senior Survey to investigate the differences between STEM majors and non-STEM majors and the value they place on their role in creating a more equitable and just society. Garibay found that STEM students who seek to become engineers, computer scientists, and scientific researchers have low levels of social awareness and view the importance of working for social change as less important to their career goals. In addition, students who have spent time as a STEM major are more likely to show signs of lower social awareness at the end of college, and majoring in a STEM field does not enhance student understanding of diverse global communities. The study found that STEM undergraduates are more likely to believe that the individual cannot change society or influence social issues than students majoring in humanities or the social sciences. STEM majors, compared to non-STEM majors, are comprised of students that most likely describe themselves as not socially concerned towards marginalized groups and more focused on solving "first world" problems (Garibay, 2015). These findings are particularly significant in light of recent calls for STEM education to play a larger role in eliminating the social inequalities and injustice around the world and improving the human condition. In 2004, the Accreditation Board for Engineering established new education standards requiring that students learn about contemporary issues and the impact of engineering on society locally and globally (Garibay, 2015, ABET, 2003).

For example, when Hurricane Katrina struck New Orleans in the summer of 2005, engineers saw the destruction as a systematic failure and breakdown of the levee system, and often at times, the same engineers failed to see a relationship between the destruction of the levees and social inequity. When Superstorm Sandy struck the East Coast in the fall of 2012, scientists pointed a finger to the adverse effects of climate change that contributed to the strength of the storm, yet the same scientists ignored how socioeconomic class offset the effects and impact of the storm for some. As the public became aware of the water crisis in Flint, Michigan during the spring of 2016, we stood in awe questioning how a natural resource such as water could become tainted with lead and ignored by those in charge, however, as a society we failed to address how engineers approved the switching of water pipes that caused this disaster and what their role was in its prevention. Even the passing of the National Highway Act in 1956 had unintended or unforeseen circumstances placed upon the communities in which highways were built. The highways were seen as a fast and efficient way to get to the suburbs from the city and vice versa, yet similar to the examples above, the tendency is to ignore the communities and people that became displaced from the areas through which these same highways are built. Throughout history, natural and man-made events have redefined people's way of life.

Many times it is engineers, scientists, and IT specialists that provide solutions to the problem and often, at times, suggestions for future prevention. But from what lens are these individuals viewing the problem and how do they see the affected communities? There is research that investigates STEM's impact on the community, but little evidence exists that examines how STEM students view the people, cultures, and issues that impact these communities. Moreover, there is even less research on how a STEM student's perceptions of other groups influence their field of work and how their understanding of the global community

and diverse individuals can benefit society as a whole. To support this claim, a December 2017 *Washington Post* article discussed a study conducted at Google which identified the top characteristics of success at Google. These characteristics are defined as "soft skills" and,

> being a good coach; communicating and listening well; possessing insights into others (including others different values and points of view); having empathy toward and being supportive of one's colleagues; being a good critical thinker and problem solver; and being able to make connections across complex ideas. (Strauss, 2017)

STEM students understanding and engagement with individuals of different backgrounds, with diverse groups, knowledge and awareness of social issues and the global community is vital for their success as an individual and is instrumental in the progress, growth, and prosperity of our society.

The New Jersey Institute of Technology (NJIT) is a STEM-based public university that prepares students to enter leadership roles in science, engineering, mathematics, and IT professions in the technology-dependent economy of the 21st century. Students enroll at NJIT to put themselves in an advantageous position in the growing STEM job market upon graduation, and to earn a degree relevant to their career pursuits and fields of interests. These students are the future engineers that will build levees, respond to natural disasters, build community infrastructure, and construct highways all over the world. STEM education has become a major focus in higher education, as the number of degrees awarded in STEM fields grew 55 percent from 1.35 million in the 2002-2003 academic year to over 2 million in the 2011-2012 academic year. Additionally, the number of jobs in STEM fields increased 16 percent from 14.2 million in 2004 to 16.5 million jobs in 2012 (Government Accountability Office [GAO], 2014). As students gravitate towards the STEM fields there is more attention being given to making the STEM field

more diverse, however, there is limited literature on how STEM institutions draw awareness and educate its students on the issues of social justice, social inequity, and diversity. Moreover, there exists minimal literature that discusses how specifically STEM education can influence social and cultural change. A strong point of consideration educators should focus on is how STEM-based higher education institutions can utilize specific courses to effectively engage in dialogue and generate awareness towards social issues and social inequity. This is a problem that requires examination and investigation.

Problem of Practice

I teach Science, Technology, and Society (STS) courses at NJIT. STS courses are designed to prepare lifelong learners to participate effectively in a technologically orientated economy. STS addresses emerging questions about effective strategies for improving student understanding of the nature of science and prepares scientifically literate citizens for the 21st century. Students analyze real-life problems and issues to investigate, evaluate, and apply concepts to new situations within a student-centered environment to increase their creativity, critical thinking and problem solving skills (Akcay & Akcay, 2015). STS courses initiate students into critical thinking and self-education beyond the STEM disciplines (Ozakats, 2013). Students at NJIT are required to take six lower-level credits in the social sciences and humanities as part of their general education requirement (GER). However, historically these classes are not often required toward their STEM major, and perhaps as a result, students often fail to engage in meaningful dialogue on social issues and social inequity and how these issues play out in their STEM fields.

The term STEM came into education lexicon during the 1990s from the National Science Foundation. STEM evolved out of government policy with the NSF and was referred to as

SMET. SMET was eventually changed to STEM. STEM initially started out as an attempt within the United States' to influence both vocational and economic agendas (Blackley & Howell, 2015; Sanders, 2009). Due to the difficulty of educators to enact policy and curriculum addressing STEM, STEM became "S.T.E.M" so as to address the specific subject matters within the STEM fields (ie: science, technology, engineering and math). S.T.E.M eventually evolved into "STEM Education" and lastly "integrated STEM Education" where all four subject areas are combined and students make connections between the subjects and real world applications. Recently the National Science Foundation has defined STEM more broadly to include the social behavioral sciences, psychology, sociology, economics, and political science (Breiner, Sheats-Harkness, Johnson, & Koehler, 2012). Since the integrated STEM model is relatively new and as STEM as evolved since the 1990s, there is not much discussion regarding the incorporation of social issues in the discussion of STEM. Much of the literature reviewed addresses racial and gender diversity in STEM, however historically speaking, the focus of STEM has always been on science, technology, engineering, and math. Therefore, discussion social issues and social inequity's relationship to STEM is something that has not traditionally been the focus of educational institutions.

With future scientists, engineers, technologists, architects, and mathematicians in a rapidly growing STEM-based economy as my focus, I investigated to what degree a STS course focused on social issues and social inequity influences student perceptions of social issues and social inequity, and to what degree, if any, their work can be seen as a catalyst for social change. As discussed in the examples such as the National Highway Act, Hurricane Katrina, Superstorm Sandy, and the Flint, Michigan water criss, STEM majors play crucial roles in the outcomes in each of these situations. If the STEM majors involved in these events were educated on the

prevalent and relevant social inequity issues that accompany these major events, the outcomes, responses, and reactions might be different. NJIT's website states,

> NJIT aims to produce well-rounded students with keen intellects and sharp social consciousness…But nonetheless, all of our students must take a mix of classes that will teach them to think critically and deeply… NJIT produces engineers and scientists, architects and lawyers, programmers and designers, all of whom will have an immense affect on American and international cultures. Our graduates must thus have a deep understanding of American culture, and of world cultures: It is the GUR that gives them that understanding." (njit.edu)

Given the educational focus on STEM education at NJIT, I examined if an STS course can be redesigned to introduce students to social issues and social inequity, to teach students how to think critically and deeply about the impact of their work has on these issues, and if students leave the redesigned STS course with a deeper understanding of themselves, and a broader perspective of social issues and social inequity. I investigated if the redesigned STS course drew student attention to social issues and social inequity. Further, I was interested to see if the course provided students opportunities to draws connections between their field of study and the issues addressed in the course. NJIT indeed produces engineers, scientists, architects, and designers, however, it is yet to be determined in what ways and in what capacity students walk away from their STS educational experience with a better understanding of social issues, social inequity, diversity, as well as, other groups, people, and cultures.

Context

My study took place at the New Jersey Institute of Technology (NJIT) located in the University Heights district of downtown Newark, NJ. NJIT is an urban campus on 48 acres,

surrounded by Rutgers-Newark, Essex County College, and the former UMDNJ. It is 20 minutes from New York City via train. The in-state tuition is $15,602, which makes it an affordable higher education institution for New Jersey residents. NJIT offers 125 undergraduate and graduate degrees and many of NJIT's students are either the first in their family to go to college or from immigrant families. The population of NJIT is 7,286 undergraduate students, of which 76 percent are male and 24 percent are female. The university has a strong resident and campus life, as well as, a large commuter population.

STEM based higher education curriculums are designed to develop leaders across the disciplines of scientific knowledge, to strengthen connections and relationships between STEM research and national goals, to develop relationships and partnerships that promotes science and engineering, to produce top notch scientists and engineers for the twenty-first century, and to raise scientific and technology literacy for all Americans (NSF, 1996 & 2018). STEM education provides students with an interdisciplinary educational experience that is comprehensive and gives meaningful real-world application and effectively develops learning experiences for those in STEM driven careers (Gomez & Albrecht, 2014).

STEM courses and programs engage students in STEM competencies, provide greater understanding of STEM work, while increasing education on the global economy and preparation for the workforce. The global economy increasingly requires persons with scientific, engineering, and technological skills so the United States can lead in a STEM based economy. Currently, the US lags behind other industrialized nations in the number of undergraduates receiving degrees in STEM (Piper & Krehbiel, 2015; NSF, 1996 & 2018; Xue & Larson, 2015; Tseng, Chang, Lou, & Chen, 2011). Students do not enroll in NJIT to take STS courses, but rather to earn a degree in STEM and seek immediate high paying employment upon graduation.

It is seen as a great value for students and, according to the U.S Department of Education College Scorecard, NJIT is first in public universities in New Jersey in post-graduation earnings. In addition, the Brookings Institution identified NJIT in the top 1 percent of colleges and universities in the United States for its occupational earnings power.

I designed a two-month long intervention module for STEM students taking an STS course and addressed social issues and social inequality issues and their connections to STEM fields. The intervention module introduced specific examples that relate to social issues and social inequity and I assessed student views, engagement, and perspectives on specific issues. The following research questions guided this qualitative study:

1) How did STEM students in the Honors College at NJIT taking an STS course perceive the relationship between STEM and social issues and social inequity?
2) How did STEM students in the Honors College at NJIT taking an STS course engage with the two month long intervention module and how were their observations, perceptions and experiences as a STEM student reflected in their discussions and understandings about issues of social inequity, diversity, and social justice?
3) From the perspectives of the students and the researcher was there a change in their perceptions of social issues and social inequity after implementation of the two-month long module in the STS Honors course?

Theoretical Framework

This study was built on the foundation that education centered on human rights awareness that focuses on critical thinking and the ideals of tolerance of diversity, taking and arguing positions, while respecting others fosters an educational culture where students evolve into critical thinkers and develop the knowledge, skills, and attitudes required to participate in

reflective civic action (Banks, 1991 & 1993; Clarke-Habibi, S., 2005). And that education should help students understand various types of knowledge and engage students in civil discourse while aiding them in the creation of interpretations, perspectives, and understandings of their own positions, beliefs, ideologies, and assumptions (Banks, 1991 & 1993).

The exploration of cultural characteristics, individual experiences, and diverse perspectives are teaching tools that tap in to the cultures and realities of all students and expands the curricula and knowledge of a student's educational experience (Ladson-Billings, 1995). Education allows for an exploration into commonalities and unifying tools in the stories and experiences of students by reading and conversing about student experiences in the communities and analyzing civic problems students face. Engaging students and connecting their academic experience to the realities outside of school, as well as peer assisted, collaborative learning, and an equitable pattern of social grouping creates an inclusive and cooperative school culture that resists social inequality and fosters a common understanding of one another (Ladson-Billings, 1995; Carter, 2013; Rubin, Hayes, Benson, 2009).

Since the role of higher education is to develop socialized minds that allow individuals to develop an understanding of themselves, their place in the world, and their role within larger contexts of society (Dewey, 1916), the school environment and culture should provide students opportunities to escape their limitations, give them areas to explore their individuality, analyze their problems, and discover their place in the world (Dewey, 1916). School and the world outside of school are not separate, isolated segments of life. Rather, both spheres work together to tap into the imagination of a child, move us from difference towards commonalities, and take into account the social, cultural, political, and personal realities of our time (Dewey, 1916; Martin, 1994; Greene, 1988).

Students enter university life as separate individuals and bring with them *habitus* and varying degrees of social and cultural capital (Bourdieu, 2000). Thus, the role of the university is to develop a student's sense of his or herself, to provide exposure and interaction with diversity, and to allow the analysis and evaluation of the transmission of culture from the home and community into the university setting. A fundamental characteristic of the education system is to help develop core beliefs or a philosophy, help understand others' philosophies, and in turn, help them with our own social and moral problems of the day (Dewey, 1916). Another role higher education plays is to teach students to resist division, embrace difference, foster a sense of community and belonging (Greene, 1988). Higher education provides opportunities for students to broaden and enhance their social perspective to better understand the world and groups of people we engage with every day. Further, using the sociological imagination allows individuals to develop the awareness between the individual and the larger society (Mills, 1959; Dewey, 1916; Greene, 1988).

Thus, this theoretical framework rests on the idea that education helps to resist division, embrace difference, and to foster a sense of community and belonging (Freire, 1970; Greene, 1988). Education provides the tools for students to analyze, evaluate, and connect life outside of the school with life inside the school, and create new possibilities and perspectives. Education aims at stopping social inequality reproduction by creating environments and school culture conducive to learning and aims to stop social inequality, embrace diversity, address issues of social justice and inequity, while broadening and expanding student's individual and social perspectives (Dewey, 1916; Greene, 1988; Bourdieu, 2000; Mills, 1959; Banks, 1991 & 1993).

Chapter 2: Literature Review

As STEM education continues to play a pivotal role in higher education and the global workplace, other factors are often overlooked. Scientists researching the next breakthrough, engineers designing the future of our infrastructure, cars, and buildings, mathematicians and technologists- who work on algorithms and apps to make our lives easier, faster, and more efficient; it is important to consider the role social responsibility plays in the educational experience of students in higher education. Further, it is quite possible that students can leave a 4-year STEM institution without much more than a superficial knowledge of social issues. Therefore, researchers and academics should consider how pedagogical practices can help students in higher education become more socially aware students and socially responsible citizens as they enter the global workplace.

This literature review is broken into two parts with each part consisting of several sub-sections. In part one, I discuss STEM education, STS courses, higher education's role in fostering social responsibility, self-reflection as a pedagogical practice, and an exploration of different educational practices around the world that promote social responsibility. In part two, I discuss social justice education programs and courses in universities, the implementation of social justice pedagogical practice, and social justice perceptions and beliefs of university students.

The literature presented in the areas of STEM education, STS (Science, Technology, and Society) courses, higher education and its role in social responsibility, and self-reflection as pedagogy, are a backdrop to the study and meant to provide background information and knowledge to the reader. As part one of the literature review is more theoretical than empirical, part two focuses on studies that address and discuss attitudes and perceptions of college students

towards social justice. In addition, part two also look at studies where courses and classes in higher education use service learning as a method to expand cultural competency, as well as, different types of teacher preparation courses. One of the reasons I chose the studies selected in part two is to demonstrate how other colleges and courses address social issues and the different types of pedagogy used to address them.

Part one begins with a review of the literature pertaining to STEM education. As STEM has become a focus of many higher education institutions it is necessary to provide a brief background on STEM education, what is the purpose of STEM, and STEM's role in current conversations in higher education (Garibay, 2015; GAO, 2014; NSF, 1996 & 2018). Next, I discuss Science, Technology, and Society (STS) courses in higher education. STS programs provide a humanities and social science based education to STEM majors and offer discussions pertaining to race, social inequality, social issues, and their relationship to scientific and technology driven society. In this section I examine general aspects of the STS program, the role STS courses/programs play in a STEM student's educational experience, and the degree to which STS courses engage in highlighting social issues for STEM students (Ackay & Ackay, 2015; Ozakats, 2013; Weiss, 2015). There is minimal literature and studies done on higher education STEM students that focus on or addresses student views and beliefs towards social, cultural, and global issues. Specifically, what are STEM students' thoughts and reactions when they are introduced and discuss issues beyond their STEM scope? And do they consider these topics and issues in their work? Thus, in the third section of part one, I continue a conversation begun by many researchers and literature regarding higher education's role in fostering student awareness towards social responsibility (AACU, 2016; Mansilla & Jackson, 2011; Hurtado, 2007; AACU, 2008; Rickels et al., 2013). In the fourth section I discuss self-reflection as a learning tool for

students (Dewey, 1912; Schon, 1987; Brookfield, 1995). There is an abundance of literature discussing self-reflection, however, there is minimal literature and studies done on higher education students engaging in the practice of reflective thinking on content that addresses social, cultural, and global issues. Specifically, what are students' thoughts and reactions when they are introduced and discuss issues beyond their STEM scope? And do they consider these thoughts and issues in their work? In the final section of part one, I discuss and provide examples of educational programs from around the world that address social responsibility to demonstrate how higher education institutions in the United States can learn from (UNESCO, 2015 & 2018; Sklad, Friedman, & Park, 2016; Darling-Hammond, 2010; Tobin, Hsueh, and Mayum, 2009; Davies, Evans, & Reid, 2005).

In part two, I begin discussing and evaluating qualitative studies that focus on social justice educational programs in higher education (Hirschinger-Blank, Simons, Finley, Clearly, & Thoerig, 2013; Tinkler, Tinkler, & Miller, 2014; Finfeld & Collins, 2008). In the next section, I evaluate quantitative studies that address social justice educational programs and pedagogy in higher education (Miranda, Radlife, Cooper, & Eschenbrenner, 2014; Torres-Harding, Siers, & Olso, 2011). Afterwards, I analyze mixed method studies that focus on student beliefs and perceptions of social justice issues (Ross, 2014; Chavez-Reyes, 2014). Lastly, the "filling in the gaps" section attempts to make sense of the themes, highlight the gaps in the literature in all three sections, and offers how the current study will contribute to this field of research.

Part One

STEM Education

The purpose of STEM education is to develop leaders across the disciplines of scientific knowledge, to strengthen connections and relationships between STEM research and national

goals, to develop relationships and partnerships that promotes science and engineering, to produce top notch scientists and engineers for the twenty-first century, and to raise scientific and technology literacy for all Americans. STEM education prepares undergraduate students for some of the most significant challenges in the 21st century that include "cybersecurity, health disparities, competing global economies, sustainability, education, equity, and civil rights" (AACU, 2016). And students pursuing STEM degrees who will meet these types of STEM challenges also require " the capacity to apply disciplinary-specific knowledge to solving the world's most complicated problems in culturally nuanced contexts and the ability to effectively communicate the importance of these problems and solutions" (AACU, 2016). Further, students who are well-prepared to enter the global workforce in the fields of innovative science, technology, engineering, and math (STEM) are vital to the nation's health and economy (NSF, 1996 & 2018; AACU, 2016).

STEM education provides students with an interdisciplinary educational experience that is comprehensive and gives meaningful real-world application and effectively develops learning experiences for those in STEM driven careers (Gomez & Albrecht, 2014). STEM develops 21st century proficiencies as adaptability, communication skills, social skills, non-routine problem solving, self-management, collaboration, and systems thinking. Today's student and citizen must be educated in this field to address global issues such as energy and resource use and climate change and its impact on environmental quality. STEM education is seen as an essential ingredient in preparing students for careers of the future. Colleges and universities across the United States with a vested interest in STEM education play a major role in generating interest in STEM disciplines (Quagliata, 2015; Piper & Krehbiel, 2015; Yager, 2015).

STEM education benefits the national economy and teachers and institutions develop integrated education programs to foster STEM knowledge, concepts, and skills. STEM courses and programs engage students in STEM competencies, provide greater understanding of STEM work, while increasing education on the global economy and preparation for the workforce. The global economy increasingly requires persons with scientific, engineering, and technological skills so the United States can lead in a STEM based economy. Currently, the US lags behind other industrialized nations in the number of undergraduates receiving degrees in STEM (Piper & Krehbiel, 2015; NSF, 1996 & 2018; Xue & Larson, 2015; Tseng, Chang, Lou, & Chen, 2011).

STEM's role in higher education in the United States has dramatically increased over the last decade. The number of degrees awarded in STEM fields grew 55 percent from 1.35 million in the 2002-2003 academic year to over two million in the 2011-2012 academic year. The number of STEM jobs increased 16 percent from 14.2 million in 2004 to 16.5 million jobs in 2012 (Government Accountability Office [GAO], 2014). Reports and programs commissioned in the United States regarding STEM education highlights three major concerns: 1) there is an immediate and future need for more scientists, technicians, engineers, and mathematicians, 2) there is a necessity for more innovative workers trained in science, technology, engineering, and mathematics, and 3) recommendations are needed from schools to address and solve this shortage of STEM students (Zollman 2011, 2012).

Many universities and colleges, federal agencies, and groups in the private sector believe STEM education addresses current and future workforce needs and better prepares students for advanced degrees and employment in STEM jobs upon graduation (Zollman, 2011; Melguizo & Wolniak, 2012). The demand for scientifically and technologically trained workers is increasing due to global competition, as workers with strong backgrounds in science, technology,

engineering, and math perform better in the global economy than workers who lack STEM knowledge and skills (Baldwin, 2009; Raju & Clayson, 2010.).

STEM is growing rapidly across the education sector to enhance the nation's global competitiveness and STEM education in the United States now must keep up with both advanced and developing countries in our current educational climate. Scientific organizations and professional societies are investing heavily into STEM programs to provide support for future workers and to support their diverse learning styles, backgrounds, and interests. They see the rest of the world excelling in STEM and desire for the United States to be a trailblazer in this field (Brown, 2011; GAO, 2014; Melguizo & Wolniak, 2011).

STEM occupations include engineers, individuals in IT, mathematicians, biomedical researchers, with varying degree levels from bachelor to Ph.D. Reports indicate a shortage of STEM workers to meet the demands of the labor market. Numerous reports detail a growing concern of policymakers and industry leaders regarding a shortage in the STEM workforce believed necessary to sustain the U.S. innovation enterprise, global competitiveness, and national security. As our society relies further on STEM for economic development and prosperity, the growing demand of STEM workforce will continue to remain in focus and the argument for increased STEM education's emphasis highlights the United States' need for more highly qualified workers, thinkers, and citizens to ensure the economic prosperity, safety, and growth for the future of America (Bartholomew, 2015; Xue & Larson, 2015).

STEM education combined with multidisciplinary engagement prepares students and educators to face global threats, produce workers for a technologically driven economy, and educates STEM literates capable to respond, react, and create informed decisions on social issues that impact the global community. This engagement provide students with a well-rounded

understanding of perspectives beyond the score of their STEM fields (Lansiquot et al., 2011; Pawson, 2012; Melguizo & Wolniak, 2012; Xu, 2013; Ferrare & Hora, 2014), develops strong relationship with other fields of study, and greater engagement, more awareness with the community, stronger comprehension of real world problems, understanding of conceptual problems, and application of these problems into the real world (Gaslewski et al., 2012; Gearheart, Perry, & Presley, 2014; Baldwin, 2009) beyond the STEM focus and makes it a global focus.

Science, Technology, and Society (STS)

Many STEM higher education institutions offer a Science, Technology, and Society (STS) program and STS courses concentrating on the humanities and social sciences. STS courses integrate science and technology and explore the connected worlds of the scientist, artist, engineer, and citizen. In addition, through the multidisciplinary approach STS courses promote global, multicultural, and environmental perspectives and strives to develop ethical awareness and public responsibility (njit.edu). At Cornell University, students in the STS program look to further their understanding of the social and cultural relationship and meanings with science and technology (sts.cornell.edu). And at Stanford University, students in the STS program take technical courses based on science and technology and courses in which they,

> study the social and historical context of science and technology, involving their global, ethical, political, organizational, economic, and legal dimensions. Through these courses, students engage with critical aspects of how science and technology are communicated, governed, and taught, as well as how science and technology affect communication, governance, and education. (sts.stanford.edu)

Some academics and researchers believe that it is in STS courses that students traditionally become aware of marginalized groups and socioeconomic inequalities. They are exposed to diverse social and cultural backgrounds, explore new perspectives and engage with varying social, economic, cultural, and political issues that impact diverse communities. They are taught to reflect on their beliefs and perspectives on social issues. Many of these courses seek to increase social awareness and foster a sense of social responsibility and while inviting students to reflect upon their individual place in the world (Braskamp & Engberg, 2011; Araband, 2015; Baxter Margold, 2004).

However, a growing criticism of the STEM curriculum is that students have limited exposure to coursework in fields outside of STEM and the courses often ignore the social impact of STEM education. Even though some students take an STS course, the exposure to the subject matter in these types of courses is limited and thus students receive minimal education on topics related to social issues. Garibay (2015) found that engineering majors expressed less interest or concern for promoting racial understanding and were found to be less committed to social action than other academic majors. In addition, the findings indicate students who spent time as a STEM major showed signs of lower social awareness at the end of college and majoring in a STEM field has a negative relationship with students and their views of the global society. STEM undergraduates are more likely to believe that the individual cannot change society or impact social issues than students majoring in humanities or social science. STEM majors, compared to non-STEM majors, are comprised of students that most likely describe themselves as not socially concerned towards marginalized groups and more focused on solving “first world” problems (Garibay, 2015). Bielefeldt & Canney (2016) conducted a study of engineering students to examine how engineering students view responsibility towards helping individuals

and society through their profession and if their views change over time. The study surveyed either in their first, second, or graduate year majoring in mechanical, civil, or environmental engineering. The majority of students who participated in the survey (57%) did not change their attitudes towards social responsibility. However, the study argues for engineering students to take service learning opportunities, courses that discuss or focus on social responsibility, and campus events as potential sources to increase social responsibility awareness.

Most recently there have been calls for STEM education to play a larger role in eliminating the social inequalities and injustice around the world and to improve the human condition. In 2004, the Accreditation Board for Engineering established new education standards requiring that students learn about contemporary issues and the impact of engineering on society locally and globally (Harding, 2006; Beckwidth & Huang, 2005; Garibay, 2015). Science, technology, and society courses (STS) prepare lifelong learners to participate effectively in a technologically orientated economy and initiates students into critical thinking and self-education beyond the STEM disciplines. STS addresses emerging questions about effective strategies for improving student understanding of the nature of science and prepares scientifically literate citizens for the 21st century. Students analyze problems and issues from real life to investigate, evaluate, and apply their concepts to new situations within a student-centered environment to increase their creativity, critical thinking and problem solving skills (Akcay & Akcay, 2015, Ozakats, 2013).

STS courses instill the belief that the STS program will make them not only better professionals but also better citizens, as the courses are more holistic, student oriented, and accessible than STEM courses (Akcay & Akcay, 2015). STS courses embed scientific principles in a social and technological context that is meaningful and useful to students by teaching and

encouraging thinking about science, technology, and society interactions. Students perceive the relevance of STS courses as low and most STEM faculty lack the background, desire, or need or to undertake meaningful integration of both STEM and STS, often STS courses are rendered meaningless. However, STS courses discuss current social, cultural, and global issues while studying the interactions of technology and society in the current societal and global climate. STS courses are viewed as social issues courses where students engage at an emotional and social level that leads to deeper learning and connectedness. The student learning experience extends beyond the objective learning of facts, concepts, ideas, and skills. STS courses opens students up to creativity, autonomy, making choices, taking individual and collaborative action, and reflection upon the consequences of ones actions. They are confronted with other's opinions and forced to formulate, articulate, and defend their positions in live social encounters (Ozakats, 2013; Akcay & Akcay, 2015).

Ackay and Yager (2010) examined the effectiveness of a professional development program that focused on the mastery of basic science concepts and the use of creativity skills towards the improvement of student attitudes toward science, and their application of science concepts and processes in new situations. This quantitative study used twelve teachers teaching Science, Technology, and Society (STS) courses or using STS strategies. Twenty-four sections of students were in STS sections and the results student-centered STS sections achieved significantly better than students in the teacher-directed STS sections in terms of understanding, creativity, development of more positive attitudes; and the ability to apply science concepts in new contexts.

Ackay and Yager (2010) argue that STS courses enable students to use scientific principles and processes to make personal decisions and to participate in discussion of issues

which influence science and technology and effect society. STS courses foster and increase skills that students require every day, such as solving problems creatively, critical thinking, cooperative learning and utilizing technology effectively in the context of human experiences. STS courses focus on current moral, social, and technological issues and prepares students for their role as a citizen. This focus identifies local, regional, national, and international issues and brings students to address the societal problems and act to resolve the problems. In STS courses there is a de-emphasis on process and rudimentary skills obtained in most STEM courses. STS courses provide opportunities to engage in active citizenship, to identify ways science and technology shape our individual and collective futures, and analyze the relevance of scientific and technological issues have on the shaping of our society (Akcay & Yager, 2010; Akcay & Akcay, 2015).

STS courses address issues of those who have advantage and disadvantage in global societal relationships. It introduces STEM students to conversations within our international community of issues such as war, diplomacy, commerce, communication, power, inequity, and economics (Weiss, 2015). Through STS courses students learn of the scientific and technological aspects of national and international issues, as well as, the political, legal, and cultural impacts playing out in our society. STS addresses critical global problems and develops measures for students to engage in conversations so their perspectives are broadened. STS courses engage with a variety of disciplinary perspectives from sociology, philosophy, anthropology, economics, and political science. Students discuss issues as it relates to ethical, legal, and societal implications and engage in conversations regarding human rights, global citizenship, and governmental influence in day to day life (Faulkner, Lang, & Lawless, 2012; Weiss, 2015).

Dolu (2016) conducted a qualitative study and a questionnaire of 102 senior students attending a university located in western Turkey. This study examined student opinion on STS and the relationship to other sectors of society. Students believe that STS has a relationship with all parts of human life and is inseparable from human life. Further, students made connections and relationships between natural events, education, energy, communication, and health. The study concluded, also, that students view a positive and negative relationship between STS and society. The study argues that students believe science and technology can be both beneficial and harmful to people.

STS courses working in conjunction with STEM courses prepares students and educators to face global threats, produces workers for a technologically driven economy, and educates students to respond, react, and create informed decisions on social issues impacting the global community. This engagement provides students with a well-rounded understanding of perspectives beyond the scope of their STEM fields (Lansiquot et al., 2011; Pawson, 2012; Melguizo & Wolniak, 2012; Xu, 2013; Ferrare & Hora, 2014), develops strong relationship with the STS fields, as well as, greater engagement, more awareness with the community, stronger comprehension of real world problems, understanding of conceptual problems, and application of these problems into the real world (Gaslewski et al., 2012; Bouwma-Gearheart, Perry, & Presley, 2014; Baldwin, 2009).

Higher Education's Role in Fostering Social Responsibility

Social responsibility is fostered through interaction and engagement with community-based programs, pedagogies that focus on social responsibility, programs emphasizing and the promotion of learning across differences (AACU, 2017). One of the "Essential Learning Outcomes" of undergraduate education, according to the American Association for Colleges and

Universities (2017), is that outcomes and learning objectives of higher education institutions should include "personal and social responsibility" specifically focusing on "civic knowledge and engagement- local and global," "intercultural knowledge and competence," "ethical reasoning and action," and "foundations and skills for lifelong learning" (AACU, 2017). And the Association of American State Colleges and Universities (2017) argues a critical educational responsibility of higher education institutions is to promote civic engagement (AASCU, 2017). The undergraduate experience includes more than focusing on a major or specific academic discipline. Rather, it also focuses on students creating a sense of civic responsibility for themselves and community engagement through programs such as the "American Democracy Project. "The goal of the American Democracy Project is to produce college and university graduates who are equipped with the knowledge, skills, attitudes and experiences they need to be informed, engaged members of their communities" (AASCU, 2017).

Social responsibility in education elevates awareness and raises the consciousness of the student from a localized perspective to a broader, more global one. Socially responsible students are globally competent and learn the capacity to understand and act on issues of global importance. They recognize multiple perspectives, communicate effectively, and take action towards the improvement of the conditions around them (Mansilla & Jackson, 2011; Tyack and Tobin, 1994; Dewey, 1912). Students learn of a universal-social responsibility they share with others in their environment and learn to empathize with the plight of those viewed as different (Dalai Lama, 1999). The world is seen as a shared environment for all and by looking at others as members of an extended family, we begin to take care of those who are the neediest, and become individuals acting in a social environment who are connected to other individuals. Students learn that their actions have intended and unintended consequences and it is through the

learning of social responsibility do they become in tune with and aware of these unintended consequences (Dalai Lama, 1999; Dewey, 1912).

Higher education lags in the development of civically minded and socially responsible individuals, studies indicate higher education faculty and administrators are willing to develop civic engagement behaviors and capitalize on the high value college students place on social responsibility, social, cultural, and political issues (Whitley & Yoder, 2014; AACU, 2008). A 2007 study conducted by the Association of American Colleges and Universities found colleges and universities across the country seek to focus more on personal and social responsibility. The study found colleges and universities strive to promote the importance of personal and social responsibility as a necessary component of a college of education. Of the 23,000 undergraduate students and 9,000 campus professionals surveyed, a majority of faculty, administrators and students surveyed on the twenty three campuses believed that personal and social responsibility should be a major focus of attention at their own college or university. Students believed personal and social responsibility should be a major focus on college campuses. They also believed colleges and universities should focus on contributing to the larger community, should take the perspectives of others more seriously, and develop competence in ethical and moral reasoning, while engaging in meaningful practices as a responsible global and local citizen. Further, the survey indicated that, even though there is a perceived value toward these two topics, all the surveyed groups reported that there campuses were not focusing enough attention or providing enough education towards social and personal responsibility (AACU, 2008).

Fostering social responsibility in higher education exposes students to multiple perspectives, cultural, and social issues. Higher education's role is to improve the health of society, to educate citizens of this generation and the next, and provide tools to individuals to

responsibly, reform, correct, and change current social problems and this ideology engenders conversation regarding the economic, racial, and social differences in our time (Hurtado, 2007). Even though the Association of American Colleges and Universities stressed the important role that higher education institutions has on social responsibility and global learning during the undergraduate years (AACU, 2008), with limited research and it being a relatively new topic in STEM, social responsibility remains an issue requiring further research with many questions still unanswered (Baker, 1981; Bradshaw & McPherron, 1978; Rickles et al., 2013; AACU, 2008).

Social responsibility positively impacts the community, culture, and university environment. Incorporating social responsibility in the undergraduate curriculum connects students to environments, develops links between knowledge and practice, and instills post graduates in community engagement and civil service behaviors. Researchers argue that both curricular and extra-curricular civic engagement opportunities should be designed to build on students' previous experiences to connect them to their new environment, develop links between knowledge and practice, and foster post-graduate civic engagement interactions (Whitely & Yoder, 2015; Schulz, 2014; Garibay, 2015). Universities fostering an environment promoting consistent engagement towards the community from its students and incorporating social justice issues, cultural issues, and global issues into undergraduate curriculum engages the students in cooperative learning opportunities and opens new experiences for students. Students engaging in civic learning gain experience in diversity and interact with diverse and varying intellectual perspectives. This has a significant impact on the culture and community of the university where students engage in diverse perspectives, engage in relationships and connections to the broader social contexts, and make informed judgements about social, cultural, and political issues (Glass & O'Neill, 2012; Nicholson & DeMoss, 2009; Liss & Liazos, 2010).

Today, university campuses seek to create learning environments where students engage in meaningful practices, work, and collaboration with others to be socially responsible local, regional, national, and global citizens and universities are slowly focusing on students exploring personal, social, and ethical responsibilities to others (AACU, 2010). Through a public social responsibility inventory survey (PSRI) higher education institutions view the perspectives and ideas of their faculty, students, and administrators and analyze key aspects of personal and social responsibility. One of the key components of this survey draws attention to university students and how they contribute to the larger community, take into account the perspectives of others, and develop their sense of ethical and moral reasoning and where it is applied and put in action. The PSRI survey refocuses the higher education institution's mission of fostering and developing student personal and social responsibility. Through this initiative institutions are steering students to explore the ethical role they play as citizens, as students, and as members of the global community (AACU, 2010).

Whitley & Yoder (2015) conducted a study where they sought to determine the impact of curricular civic engagement, extra curricular civic engagement, and participation in a living-learning community on the attitudes and behaviors of students toward social responsibility and civic engagement. A survey of 1240 undergraduates found that it was extra-curricular civic engagement that had the most impact. And that student's attitudes and perceptions towards civic engagement is already high and thus, instructors should utilize those perceptions and foster its growth. The study identifies the greatest potential for growth rests in political engagement. And that since universities are becoming increasingly interesting in incorporating civic engagement into their undergraduate education, understanding the relationship between civic and political engagement could lead to the goal of enhancing students' leadership skills and foster an

environment where socially responsible global citizens are created. Student experiences with curricular and co-curricular activities that promote diverse experiences strengthens undergraduate's social connections with those outside of their self-defined group and they are more aware to other group experiences when they experience the ways individual lives are shaped by others (Whitley & Yoder, 2015).

Student engagement with a classroom community inspires active learning, engagement, and allows students to develop their individuality (Neumann, 2014). Motivating students pushes them towards success and sustains them throughout their learning process. Factors such as quality of instruction, relevance and pragmatism are key components in ensuring a student's quality educational experience. Quality instruction allows student engagement with the content knowledge of the subject and it is through the instructor students learn to communicate, verbalize, articulate, respect, listen, empathize, and discuss issues impacting culture and society. Students engage with relevant material that connects with their lived experience and pay more attention to the content area. This relevance generates interest, and when students are interested, they are motivated to learn, engage in meaningful learning, and discover its applicability in their world and the world outside of them **(**Neumann, 2014; Sogunro, 2015).

When universities address the needs of the larger, diverse student population increases the chances of building common understanding and relationships through cooperation and collaboration. This new relationship seeks to address complex global problems and create a sense of shared purpose (Neumann, 2014; Sogunro, 2015; Ramaley, 2014). Thus another role of higher education is to educate citizenship among undergraduates, while preparing students for both life and work (Ramaley, 2014). Higher education institutions with a focus on collaboration with the broader society fosters relationships with the community, generates knowledge, and helps

students acquire skills, knowledge, and experience to work effectively with other groups and to address complex issue. Higher education institutions play a significant role in fostering this type of environment for students of all backgrounds, lifestyles, and perspectives. This communal and society partnership forces students to pay attention to other's ideas, analyze and dissect complex problems, understand the other, and see and make connections that allow for individuals to see the world and interact with the world in creative and cooperative ways. Students who are engaged with the community work together on a problem in collaborative ways that influences our interactions with numerous groups, how we are informed, react to problems, and seek solutions. Universities shifting their focus from a business like style education model and discussing the interests of the community at large, societal challenges, and shared knowledge creates learning communities where education is reflective, self-aware, and universal.

Higher education institutions meet the needs and demands of the 21st Century learner by incorporating more critical thinking and problem solving, communication and collaboration. When creativity and innovation are promoted there is an embrace of a new global community of shared understandings and communal interests (Kivunja, 2014). The 21st century learner addresses and solves problems that take into account the needs and care for the society and environment at large. Critical thinking is a necessary domain for this group, communicating effectively and the ability to articulate ideas while listening to other perspectives and converse back and forth are requirements. Communicating in different contexts, (verbally, written, technologically) students increase their ability to communicate with other groups. It allows for broader interpretations and takes into accounts various cultures, backgrounds, values, and lifestyles. Collaborating demonstrates to students to reach and seek a common goals. It is through communication, listening, and discussion of other perspectives, feelings, concerns, and

ideas where broader issues and goals are addressed. Students are taught to work respectfully with diverse groups, learn to compromise and reach an ultimate goal. It is through creative and quality learning environments where undergraduates problem solve, learn about others, understand diversity, and utilize critical thinking skills to analyze, evaluate, and solve real world problems (Kivunja 2014; Ramaley, 2014; Neumann, 2014; Sogunro, 2015).

Self-reflection as pedagogical practice

Self-reflection is the process that moves learners from one experience to the other through connections and drawing inferences and requires students to value personal, emotional, and intellectual growth of themselves, others, and the relationship shared with the community (Dewey, 1912). Hullender, Hinck, Nartker, Burton, & Bowlby (2015) conducted a study of student reflective writing from an Honors service learning course a medium sized mid-western university. The study found that reflective writing aids in transformative learning, however, this type of learning requires appropriate time and space for the students to consider and reflect on how he or she thinks about the new information presented and how it impacts their understanding of experiences. The results of the study also suggest that the benefits of self-reflection as part of the transformative learning process are most effective when experiences, grounded in course content, readings, and dialogue are part of the pedagogical practice.

Self-reflection requires conditions a progressive society can promote and sustain effectively (Ulrich, 2000) and enhances the possibilities experiential learning opportunities now and in the future. Self-reflection allows individuals to see what they are doing, what happens as a result, and demonstrates relationships among ideas and for the future development of these ideas. Students engaging in reflective practice means there is a concern for the issue at hand, there is a vested interest in the issue by the student, and interest toward the impact the issue being reflected

upon has. Self-reflection requires inquiry, investigation, and an examination of the connections between what occurs and the consequences. Thus, practitioners develop a greater level of self-awareness regarding the impact of their performance and an awareness that creates opportunities for professional growth and development (Osterman & Kottkamp, 1993; Bard, 2014). It frames and develops the experience, allows for a broader personal understanding, and provides the individual the capabilities of responding to the needs, issues, and concerns that shape the situation or topic (Loughan, 2002). Self-reflection gives citizens a meaningful role in engaged citizenship and individuals realize that varying life perspectives and ideologies still can foster communication for productive engagement in society as a byproduct of our reflective practice. (Rogers, 2002, Ulrich, 2000, Loughran, 2002). It allows consideration to individual, cultural, political and social realities that limit us, as well as, the negatives of the human condition. In turn, humans become aware of their consciousness and of themselves they discover their own limits to freedom. Becoming conscious of society's realities awakens individuals and empowers them to overcome their limits and apply their knowledge, experience, and power to improve their individual lives and the collective lives of others (Freire, 1970; Greene, 1988; Dewey, 1916).

Reflection upon our experiences allows individuals to think about what has occurred, its relationship to our past, present, and future actions, and has the potential to reshape what we are doing while we are doing it (Schon, 1983, 1987). Students engaging in self-reflection utilize a learning tool that benefits and improves the understanding of interactions and relationships among people, communities and societies, both personally and professionally. The process of self-reflection allows for the analysis of individual views and theories and puts them against the theories in use. This process identifies assumptions behind thoughts and actions, evaluates the assumptions, and explores the connections to our experiences by providing opportunities to make

ideas more inclusive and integrative with multiple aspects of society (Merriam & Bierema, 2014; Brookfield, 1991; Schon, 1983).

Self-reflection in the form of self-assessments, provides students engagement in self-evaluation and allows opportunities to understand the difference between what they are learning and what they experience. Through this process, students develop independence and critical thinking skills, begin to assess their individual areas for improvement, learn from mistakes, identify problem areas, evaluate their work, and reflect on their skills, strengths, and weaknesses (Logan, 2015). Strong evidence indicates self-reflection is a vital learning tool for students. Students engaging in self-reflection engage with complex and moral questions that impact the student's identity. Research studies indicate engagement with self-reflection regarding a student's educational experiences increases a student's understanding and willingness to engage with diverse perspectives and the understanding of knowledge in a broader context. These experiences impact a student's understanding and appreciation for moral and civic learning with positive affect on student learning and makes students' lives more purposeful and focused. Students engage in considerable short-term and long-term thinking and identify relationships and connections in their work (Travers, Morisano, & Locke, 2015).

To support this idea, Olson, Bidewell, Dune, & Lessey (2016) conducted a study at an Australian University among aspiring health professionals where pre and post surveys were used to evaluate self-reflection and cultural competence. The students viewed 7-15 minute videos that interviewed individuals from diverse minorities, cultures, languages, and sexual orientations who were living with a disability or a health condition. Afterwards they engaged in a structured activity that aided in promoting cultural reflection. The findings argue there is value and merit in

group discussion on topics such as cultural competence and that self-reflection is an instrumental tool in improving understanding of others and groups.

The process of self-reflection allows students to evaluate and collaborate with their individual environment and increase their self-awareness. Graduate students in business school found that reflective practice helps students adapt to new environments and situations and forces them to engage with new information while understanding their ideas and feelings and others. It provides opportunities to evaluate one's thoughts, feelings, and behaviors (Donovan, Gus, & Naslund, 2015) and makes meaning of experiences in the environment and individual relationships. In addition, it leads to an increase in self-awareness and produces a direct benefit in an individual's professional life. In one study, therapists in training found that self-reflection led to an increased sense of self-awareness in trainees and had a direct benefit to their professional lives by an increase in the ability to self-monitor, a greater understanding of their own thoughts, feelings, core beliefs, and greater ability to challenge those when necessary. The trainees in the study asserted that self-reflection provides greater ability to understand the impact and emotionally process and analyze their own problems. There is increased awareness in relation to their interaction and interaction with others, increase in interpersonal, perceptual and relationship skills, increased empathy for their clients, and the ability to understand the impact of their own problems, as well as an awareness to other's difficulties (McGillivray, Gurtman, Boganin, & Sheen, 2015).

Self-reflection is a transformative educational process providing students with increased knowledge of the self and with the potential for life changing perspectives in students. A study conducted at a Midwestern college in an Honors service learning course found that through reflective writing students began to think critically about what it means to engage in meaningful

service, became aware of their relationship to others, how their identity, position, and influence of power impacts their experience, understanding, and service to the community. Student moved from a narrow understanding of complex issues to a perspective in which they began to question assumptions and understand what it means to be engaged in meaningful service as a leader (Hullender et al, 2015). An introductory Psychology class at the University of Texas-Austin found reflective practice through the process of self-reflection promotes knowledge of the self and its relationship to society, promoting an awareness of multiple concepts, fostering self-insight, and knowledge of the self to a better understanding of the self and the relationship the individual shares with the community in which it resides (Hixon & Swann, 1993).

The studies and research indicate that self-reflection is effective in promoting self-awareness, personal understanding, and greater knowledge and awareness towards the communities and others. Self-reflection is transformative, as it takes the individual on a journey within their inner self and provides he or she with the opportunity to examine why they think the way they do. As a result, students potentially are more cognizant of their actions, their thoughts, and their ideas. They also possibly become more aware of how their actions effect others.

Programs around the world

The education culture and practices of many nations around the world differ from the system in the United States and have shown positive results (Darling-Hammond, 2010). In countries, such as South Africa, England, and Canada, students engaged in an understanding of "global citizenship" and "social responsibility" and these educational programs provide students the opportunity to engage and reflect on issues of national concern and of social justice (Davies, Evans, & Reid, 2005). As this study focuses on American students at an American University, it

is important to consider various global perspectives and how other organizations and countries view practices such as global citizenship and social responsibility.

UNESCO states that students should 'acquire knowledge, understanding and critical thinking about global, regional, national and local issues and the interconnectedness and interdependency of different countries and populations' (UNESCO, 2015). "UNESCO empowers young women and men and helping them to work together to drive social innovation and change, participate fully in the development of their societies, eradicate poverty and inequality, and foster a culture of peace" (UNESCO, 2018). One program that UNESCO promotes and supports is intercultural dialogue which sees equipping students with the knowledge about their cultural environment and an understanding of themselves and others when interacting with people of diverse backgrounds. This culture of peace movement commits to "peace-building, mediation, conflict prevention, and resolution, peace education for non-violence, tolerance, mutual respect, intercultural and interfaith dialogue" (UNESCO, 2018). UNESCO works with law makers, students, and the youth to integrate a culture of peace in law and policy, uses formal and non-formal education as means to push a culture of peace and intercultural dialogue, and use culture of peace as a tool for social inclusion and to address issues such as ethnic tensions and xenophobia (UNESCO, 2018).

The "Going Glocal Program" aims to "strengthen students' knowledge, attitudes and skills in the field of global citizenship" (Sklad, Friedman, & Park, 2016). Implemented at a Dutch liberal arts and science college, the name is based on the idea of "glocalization"- that global change starts with local action and there is a connection between what happens locally and globally. The program is based on the notion that pedagogy and quality of educational

programs delivered to students in higher education must focus on global interconnectedness and equip students to take on global challenges, and to give meaning to the idea of global citizenship. Programs such as "The Going Glocal Program" draws student attention to structural inequalities, cultural competencies, differences and similarities, as well as, opening up topics and issues to conversation and dialogue that challenges students worldviews and guides them on a journey of transformative learning. This program was created at a Dutch liberal arts and science school with a history of civic engagement and liberal arts education. Further, a "Global Perspective Scale" was developed specifically for this program and "shows that the program had a positive effect on participating students in multiple domains: they gained a global perspective, global competence, a sense of social responsibility, and intercultural communication competencies" (Sklad, Friedman, & Park, 2016).

There are numerous other examples of countries implementing a socially responsible and civically minding curriculum as the foundation for their education system. In 1999, South Africa implemented the Tirisano (Working Together) project with a focus on the spirit of equality, human rights, social justice, freedom and equality. Since 2002, the National Curriculum in England makes it compulsory for students to be taught about the world as "a global community and the political, economic, environmental, and social implications of this and the role of the European Union, the Commonwealth, and the United Nations" (Evans, p.285, 2005). The Ontario Ministry of Education and Training agree that the importance of increased attention regarding the Social Sciences to its students and citizen (Davies, Evans, & Reid, 2005). Schools in Japan exemplify the important role environment and culture play in schools: teachers arrive early and greet students every morning; children sort out their differences among each other while adults stand back and observe; there is unstructured play, "room to stretch" or "feel at

ease" and the curriculum is described as an "absence of a curriculum." (Tobin, Hsueh, and Mayum, 2009). Singapore established a system-wide reform called "Thinking Schools, Learning Nation" which seeks to create "a nation of thinking and committed citizens capable of meeting the challenges of the future...and seeking better ways of doing things through participation, creativity, and innovation." (Darling-Hammond, 2010, pg. 6). And when Finland ended their tracking system in 1980, it resulted in an overhaul of their curriculum and assessments with a new focus on academic culture, student reflection, independent learning, problem solving, and creativity. It focuses less on the "one size fits all" teaching style and focused more on improved curriculum and teacher training (Darling-Hammond, 2010).

At both the public school level and the university level, the United States can develop and learn from organizations such as UNESCO and countries such as South Africa and Denmark. Based on the examples provided above there is heavy engagement with social responsibility and global citizenship, that sees a dependent relationship among all people and backgrounds and the community; and draws attention to the social and cultural inequalities that are experienced by various groups.

Part Two

Qualitative Studies

The qualitative studies in this review collected data from a variety of sources and methods. Researchers in these studies collected data through interviews, focus groups, reflection essays, and observations. The studies evaluate a wide range of educational programs and courses that range from an undergraduate psychology training program (Halsel, et al., 2014), to service learning courses, (Hirschinger-Blank, Simons, Finley, Clearly, & Thoerig, 2013; Tinkler, Tinkler, & Miller, 2014; Finfeld & Collins, 2008), and teacher preparation courses (Trujillo &

Cooper, 2014; Chavez-Reyes, 2014; Young Ah Le, 2014). All of the qualitative studies demonstrate that there is a high level of interest from university students to engage in meaningful dialogue regarding social justice issues, to work with diverse learning practices among various groups, and a willingness to learn about social justice and social issues that impacts others. Many of the students in the studies acknowledge their increased sense of awareness and understanding towards marginalized groups and how social justice issues affect others following their participation in the courses. Most of the qualitative studies find social justice educational programs useful and beneficial towards a student's individual and professional growth. In addition, the studies stress the importance of these programs for democratic citizenship and intergroup collaboration and reflect the important role teachers play in the practice of teaching social justice. This is a key component for a successful learning environment and highlights how instrumental pedagogical programs and practices shape student views toward social justice.

Programs. Hirschinger-Blank, Simons, Finley, Clearly, & Thoerig (2013) conducted a pilot study of a criminal justice service-learning course to investigate the value of a multicultural learning approach. The goal of the course is to broaden college student attitudes and perceptions towards diversity issues. The study uses a qualitative analysis of thirty-six university students (17 males, 19 females) who were participants in a service learning course. The students varied in major but derive from primarily the social sciences. Most of the students were white. The researchers note that most students are willing to reexamine their preconceived notions, their biases, and many offer that their perspectives changed after taking the course. The study highlights that after the course students are more aware of the issues plaguing the criminal justice system and in turn, begin looking to their own behaviors as ways to improve themselves and implement change.

Students report heightened awareness and increased knowledge of how society treats those in the criminal justice system. Hirschinger-Blank, Simons, Finley, Clearly, & Thoerig, (2013) argue that after taking the course all of the students, but one, recommend that society offer treatment and rehabilitation programs rather that incarceration and punishment. Courses such as this serves students well in search of employment by providing exposure and education to the issues that affect socially marginalized groups. This notion is supported by the study conducted by the Association of American Colleges and Universities (2010) that found most employers seek the same skills cultivated in these types of courses. Specifically, a) effective communication, b) collaboration with others in diverse setting, and c) application of learning into real life settings and community engagement.

In addition, service learning courses broaden and enhance student multicultural attitudes and expand the knowledge and skills towards multicultural and diversity issues. The development of multicultural awareness courses (that address social justice issues) provide students opportunities to develop relationships with students different from them. In addition, when students confront preconceived notions and stereotypes in certain courses, those same stereotypes and preconceived notions are often contradicted. Most students are willing to reexamine the same preconceived notions, their individual biases, and many students state their perspectives changed (AACU, 2010; Hirschinger-Blank, Simons, Finley, Clearly, & Thoerig, 2013).

After taking courses that address criminal justice issues students are more aware of issues plaguing the criminal justice system and in turn, begin to look at their own behaviors as ways to improve and change their belief system. Tinkler, Tinkler, & Miller (2014) conducted a study and examined the outcomes of a social justice service learning field experience course highlighting to

future teachers how inequity is hidden in the educational system. Using interviews, questionnaires, and reflection essays the researchers analyzed the responses of 37 preservice teachers (28 female and 9 males) and determined that there are three primary outcomes from a social justice service learning course: 1) there is greater exposure to diversity, 2) there is an emphasis on learners as individuals, and 3) and there is a broader view of the social contexts in education. Further, service learning courses produce positive effects of preservice teachers. Students report heightened awareness, increased knowledge of how society treats those in the criminal justice system, and a belief that society should offer treatment and rehabilitation programs rather that incarceration and punishment (Tinkler, Tinkler, & Miller, 2014; Hirschinger-Blank, Simons, Finley, Clearly, & Thoerig, 2013).

Though some educational programs provide assessments of the content knowledge taught in social justice programs, there is no statistical evidence indicating whether or not any change occurs between a student's initial skills and knowledge from the start and at the end of programs that address social justice issues. Trujillo and Cooper (2014) examined how universities frame social justice leadership in a leadership preparation program. They looked at social justice theories about leadership and how universities develop and promote social justice, to what extent skills and knowledge are developed in these programs, and how the material is used. They attempt to answer two research questions: 1) In what ways are theoretical concepts about social justice leadership reflected in a university-based principal preparation program? and 2) What specific tools does a university-based principal preparation program use to develop leaders with a social justice orientation?

They collected 26 syllabi over two years (2011-2013) from two different universities that represent all courses taught in programs focusing on social justice issues and leadership. The

study asserts that school administrators are social justice leaders and must continue to make social justice issues and its relationship with instructional leadership a priority. By prioritizing social justice issues students develop a broad understanding of school reform, the historical background of education, and are exposed to urban schools and students who have been historically effected by decisions both in and out of the classroom. When programs connect theories of social justice leadership to further develop understandings of institutional racism, discrimination, poverty, and other forms of oppression, the level at which change occurs is very unclear. However, integrating a social justice framework into a school training program enhances student cultural competency and highlights the need for integrating social justice into existing training models. This practice determines the extent to which students develop cultural competency and the understanding of what it means to engage themselves in socially just practices (Trujillo and Cooper, 2014; Halsel, et al, 2014).

Different teaching practices influences student learning and the degree they are receptive to social justice issues. Young Ah Lee (2014) used a M.Ed early childhood teacher licensure program in a Midwest university and selected 3 candidates out of a pool of 31 who are student teaching in an urban elementary school. The researcher collected data from multiple sources such as pre- and post-lesson conferences, semi-structured interview questions, conversations via email and telephone, e-portfolio websites, and reflective journals. The study found that social justice means different things to different teachers and this is evident in the pedagogical methods of teachers. However, teacher educators should prepare future teachers to teach for social justice by factoring in teacher candidates belief system, existing knowledge, and values. Teacher candidates should be provided opportunities to reflect and discuss their experiences (Young Ah Lee, 2014). However, in contrast, some believe that school is not viewed as a venue for social

justice learning and that the learner's emotional and cognitive understanding, their history as learners, their experiences, and their social and cultural contexts of learning greatly influence views on social justice (Anderson, et al., 2015).

Anderson, et al., (2015) used a participatory action research study to investigate social and ecological justice learning within teacher education programs. Surveys distributed to 30 teacher candidates within the teacher program and 9 semi-structured interviews conducted found that teacher candidates do not see school as a venue for social or ecological justice and there is limited understanding of learners' emotional, cognitive, and spiritual needs from the preservice teacher perspective. And in order to achieve success in social and ecological justice learning, educators must take into account the social and cultural issues that impact student learning.

If a goal of higher education is to educate for democratic citizenship, then higher education institutions should provide for social justice education. This social education should foster multicultural competence, educate students as global citizens, and make awareness towards issues of social justice a priority. Einfield & Collins (2008) interviewed 10 college students from a mid-sized public university in the Midwest, who are AmeriCorps participants, and studied the relationship between service learning, social justice, multicultural competence, and civic engagement. They wanted to determine if AmeriCorps participants have an increased understanding of social inequality and to what extend does the program effect a student's multicultural awareness and their attitudes and beliefs towards civic responsibility. The study found there is a general consensus among students that individuals and institutions should be civically engaged and contribute to their communities. However, the data also highlights that students have varying ideas of what civic engagement means. This definition is shaped by a difference in attitudes, upbringing, backgrounds, and perceptions. The study concludes that

further exploration into what is civic engagement, a pursuit of a common definition or goal of civic engagement, and what it means to be an 'engaged citizen' is critical in understanding how best to implement certain programs and how to get students involved and aware. The study argues that it is not simply enough to be aware, but rather civic engagement must be used as a tool in pursuit of democratic ideas of justice and equality in a diverse, multicultural society. Providing students educational experiences from course work, organized activities, and service learning programs gives students opportunities to engage in social justice issues hands on while empowering them to be agents of change (Einfield & Collins, 2008).

The implementation of programs promoting social justice awareness allow universities to address social justice issues. These programs are met with overall positive results from the student body and students experience a reduction of stereotypes, they find value in learning about difference, they interact across cultures, they communicate better with others, and they are more sensitive in their attitudes towards the experiences of marginalized youth (Hirschinger-Blank, Simons, Finley, Clearly, & Thoerig, pg. 14, 2013).

Quantitative Studies

The quantitative studies in this literature review use surveys, pre-and post-tests, and questionnaires to evaluate the role social justice educational programs have in higher education institutions. Studies that address university social justice educational programs (Gurin, Biren, Nagda, & Lopez, 2004), evaluate student perceptions and beliefs, (Lizzio, Wilson, & Hardaway, 2007; Garibay, 2015); examine training and intervention models and perspectives (Miranda, Radlife, Cooper, & Eschenbrenner, 2014; Torres-Harding, Siers, & Olso, 2011); and discuss specific courses related to social justice issues and awareness (Klos, Eskin, & Pashkevich, 2014; Biren, Nagda, Kim, & Truelove, 2004) are highlighted in this section.

Programs. Multicultural programs highlight the benefits of diversity education for democratic citizenship and help students learn skills necessary in a fair and just democratic society. Gurin, Naga, & Lopez (2004) used a longitudinal study of two groups of students entering as freshman. One group took a multicultural diversity class while the other did not. The groups were then surveyed four years later in their senior year. Researchers found that racial and ethnic diversity for student personal development and global citizenship is dependent upon the experiences students have with diverse peers. The authors argue it is the duty of higher educational institutions to bring students of various racial, ethnic, and cultural dynamics together in meaningful ways, to engage in civil discourse, and to learn from one another. Further, the study found great responsibility on the university to teach and train students to become culturally competent citizens and leaders. Universities that increase enrollment of underrepresented groups is insufficient for students to learn about diverse groups. Universities can start by addressing the core issues and the relationships between the equality of race relations on campus and interactions with diverse student bodies (Gurin, Biren, Nagda, and Lopez, 2004). One such method is through specific course and a focused curriculum.

An honors curriculum is an ideal venue for introducing complex conversations that can transform classroom discussions into active social change. Klos, Eskine, & Pashkevich (2014) designed a one-credit Honors colloquium at Loyola University of New Orleans to teach skills to students that are important to consider when engaging with social justice. They found by educating honors students to think critically leads individuals and their communities towards a path of a more just world.

Using surveys of an honors course the study highlights the views honors students have towards social justice and the educational value an honors curriculum has in drawing attention to

social justice issues. The study argues honors students have a belief in their own power to effect change and recognize injustice and perceive themselves as actors toward social justice. Honors students see the value of a social justice focused course because it provides students with complex conversations and, the study argues, transforms classes into an engagement and exercise in active social change. The honors curriculum engaged and educated students to think critically about how they may act justly while leading their respective communities.

Honors students believed in their power to effect change and appear to internalize the lessons within the colloquium. Honors students saw socially responsible daily behavior as a form of social action and are able to recognize injustice and the factors that label them as actors for social justice. The colloquium allows Honors students to think critically about how students influence social justice issues and how honors programs can have an impact on the community. The study concludes that conversations like these have a significant impact on social change perceptions and it educates students on a path to a more fair and equitable society However, a large limitation is that this colloquium was limited to honors students and ignores a population of non-Honors students and their potential and possible innate desire to equally improve their community. It also leads to larger questions of are honors classes the only arena where intense conversations about social justice occur? What types of opportunities do non-Honors students have to address the same issues? (Klos, Eskine, & Pashkevich, 2014).

Student learning and understanding of topics of inequity, diversity, and social justice increase when there is learning about other groups, when attempts are made to bridge intergroup differences, and when reflection is done on one's own group dynamic. In their study about intergroup learning in a course titled "Cultural Diversity and Justice," Biren, Nagda, Kim, & Truelove (2004) administered pre- and post-tests to 231 and 175 students respectively and found

that student learning about difference and learning with others increases student motivation towards intergroup learning. In addition, there is emphasis on the importance of taking action to reduce prejudice and promote diversity. Interventions that enlighten students and provide them opportunities to encounter social justice issues and diversity motivates students for intergroup learning. By focusing on learning about difference through various learning modules there is an increased motivation for student learning. It is through this learning where student understanding of the importance of prejudice reduction, a promotion of diversity, and working with students of all backgrounds increases in importance. In addition, this increase is also due in part to the content in lectures and readings and intergroup dialogue. These all positively contributed to student increased awareness and knowledge of the importance of intergroup workings and reduction of prejudice (Biren, Nagda, Kim, & Truelove, 2004).

The quantitative studies in this literature review find a general consensus that students benefit from multicultural educational programs and they value the exposure and interaction with diverse groups in the university setting. However, many of the quantitative studies place responsibility on the universities to cultivate an environment that encourages conversation, intergroup collaboration, and interaction Klos, Eskin, & Pashkevich, 2014; Biren, Nagda, Kim, & Truelove, 2004; Miranda, Radlife, Cooper, & Eschenbrenner, 2014).

Beliefs. Students construct the idea of fairness from their learning environment. A clear relationship emerges between the relationship a student has with fairness, teaching quality, the learning environment and how positively they view their department. Lizzio, Wilson, & Hadaway (2007) investigated how students construct the concept of ‘fairness’ at the university level. Their research identifies how university students define ‘fair treatment’ and how student views of social justice relate to identification with their academic department. The study used

two questionnaires and is distributed to three hundred and forty-two undergraduate behavioral science and psychology students from 17 to 59 years of age. Students defined fairness as having a respectful partnership between staff and students and that systemic fairness means all people having access to information and problem-solving strategies. When the curriculum reflects the dominant culture, socioeconomic, racial, and ethnic inequality issues cannot be accurately addressed and students from the non-dominant culture are left out of the conversation and their voice is silenced. Universities, educators, and lecturers that adopt multiple perspectives, experiences, and alternative voices through a student's academic learning experience enables students to develop broad perceptions, identities, experiences, and further engagement with other disciplines and social understandings. The study does not expand on this or offer practical methods on how to achieve this (Lizzio, Wilson, & Hadaway, 2007).

A student's major and their experiences in the classroom are influential in developing their perceptions and understandings of social inequality and injustice (Lizzio, Wilson, and Hadaway, 2007). STEM students, for example, show less signs of social agency and social awareness at the end of college as compared to non-STEM majors (Garibay, 2015). Garibay (2015) surveyed a national sample of over 6100 undergraduates and found that STEM majors are more likely to see their field of work as not something that can contribute to the overall promotion of social justice issues. Students value fairness when interacting with their professors, access to information, effective problem solving, and responses to feedback. If students have strong relationships with their academic discipline and professors, they are more likely to be receptive to information and discussions presented in courses that address social issues. However, there is no data as it pertains to observations, reflections, and perceptions of students

and their views toward others of different racial, ethnic, and cultural backgrounds (Lizzio, Wilson, and Hadaway, 2007; Garibay, 2015).

To address student perceptions and beliefs towards social justice issues, Torres-Harding, Siers, and Olson (2011) developed a social justice scale to assess student perceptions of social justice. The scale was developed to measure the intention to engage in social action that includes social activism, the will to serve others, and the desire to empower groups from disadvantaged backgrounds. The scale was administered to both undergraduate and graduate students with the intention that this scale can measure social justice perceptions and the desire to engage in social justice training and pedagogical interventions that promote social justice. The study found those that responded were more likely to agree that race and gender play a significant role towards how people are treated in our society. In addition they sympathized with individuals of different race and gender and believe that the world is not a fair or just place for them. Those students who answered positively already have developed a sense of awareness and are less likely to blame marginalized groups or groups from disadvantaged backgrounds for failure. A limitation of the scale is that it does not measure behavior but rather assesses intentions to engage in social justice actions. The study argues that it is reliable and valid assessment tool with the hope that by assessing and scientifically predicting factors that contribute to social justice that higher education can help its students move towards a more fair, just, and equitable world. However, none of the studies in this literature review used this social justice scale to assess student perceptions.

Practice. Cultural competency and understanding of social justice improves when students are exposed to course work and field based training. Miranda, Radlife, Cooper, & Eschenbrenner (2014) use a school psychology training model as a basis for their study that takes

social justice from an aspiring idea to a form of practice to lead students as agents of change. The study collected data in the spring from 2010-2012 from psychology graduate students. Surveying 36 participants, the study found that cultural competency and understandings of social justice improved after two years of course work and field based training. However, these are only short term goals and a larger discussion is how this training plays out in the everyday personal and professional lives of students. The study fails to discuss what happens after the study and if students integrate what they learned in their experiences in their everyday lives. The study concludes that there is a need to adopt philosophies of social justice and a need to integrate self-evaluation as it relates to social justice. Meaning universities must evaluate to what extent students develop cultural competence and how it plans to engage in social justice practice. Social justice infused with multi-academic and multi-disciplines with faculty creates opportunities for students to collaborate with the broader community, exposes students to social justice issues, encourages self-reflection, and students become change agents with increased student self-awareness and understanding of social justice (Miranda, Radlife, Cooper, & Eschenbrenner, 2014). However, these are only short term goals and as stated previously it is uncertain how this training plays out into the everyday personal and professional lives of students and it is unclear what happens after the study if students integrate what they learned in their experiences in their everyday professional and personal lives.

Mixed Methods Studies

The two mixed methods studies in this literature review evaluate student beliefs towards social justice issues. The studies found that the university environment and what a student majors in at the university plays a significant role in how he or she learns about social justice issues and

how it influences their perceptions and understandings of social justice (Ross, 2014; Chavez-Reyes, 2014).

Beliefs. In one study, students see coalition-building and cooperation among diverse groups for the mutual benefit of the student body is possible and intergroup interactions are viewed positively. However, race is the biggest barrier to coalition building and students enrolled in courses that address social justice issues believe that coalition building among diverse students and groups is possible, however, they believe that race stands in the way as a barrier towards this success (Ross, 2014). When diversity is examined and intergroup contact in higher education is addressed democratization through social justice education in the intergroup dynamics emerge when students in the courses engage in dialogue, discussion, and group activity (Ross, 2014).

Ross (2014) conducted a study of 61 undergraduate students linking diversity and higher education teaching to democratic learning outcomes by exploring the interactions of Black and White students enrolled in two sections of a diversity education course at a public university in Southeastern United States. The study uses observations and instructor notes, demographic survey, survey questions, and final reflections written by students at the end of the course. The study focuses on coalition-building and cooperation among diverse groups for mutual benefit toward the other. The study reports high percentages (approximately 90%) of students believe coalition building is possible and there are mostly positive intergroup interactions in both sections. Both sections report that race is the biggest barrier to coalition building (Ross, 2014).

An important aspect of reaching this cooperation and collaboration is through critical social dialogue. Critical social dialogue improves intergroup relations, teaches students about stereotypes placed on racial and ethnics groups, discusses the common humanity that connects social groups, and teaches skills to interact effectively with students from other groups with

learning about others and their specific environments with reduced fear and anxiety (Chavez-Reyes, 2014). Critical social dialogue is difficult to engage in and teachers must be aware of the consequences of a potential engagement of controversial topics. However, introducing critical social dialogue in the undergraduate experiences enables a framework that emphasizes multiculturalism, social justice, and democracy and is the first step towards a mutually beneficial social justice education. Critical social dialogue engages students into conversation on topics they may not have the opportunity to otherwise discuss. It presents different perspectives, ideas, and viewpoints. It allows students to the opportunity to not only challenges the perspectives of others, but also, to reflect on their own perspectives and beliefs towards topics.

Chavey-Reyez (2014) sought to answer these questions regarding critical social dialogue: 1) How did students respond to the invitation to engage in critical social dialogue, 2) What was the process of critical social dialogue, and 3) What was the student outcome of critical social dialogue. Using post surveys and reflective written assignments, data was collected from 48 sections in the Spring semester and an additional 28 students in the Fall. The study concludes that critical social dialogue improves intergroup relations, teaches students about stereotyping towards racial and ethnic groups, teaches about the commonalities of our humanity that connects all social groups, and addresses social skills to effectively interact with diverse groups of students and to learn about others environments.

These studies highlight two important factors in addressing social justice issues in higher education: race and dialogue. The studies highlight that race plays a significant role in a student's willingness to understand members of different groups. Students report a willingness to learn about other races, but ironically, also state race is the biggest hurdle to understanding other groups. However, it is through conversation and critical social dialogue among diverse groups

where learning, understanding, and intergroup relations regarding our common humanity is most effective (Ross, 2014; Chavez-Reyes, 2014).

Filling in the Gaps

The studies above share connections and relationships with themes that stress the importance of student interaction, university programs, and experiences as a necessity to further develop social justice understanding. Each study highlights the importance of students, universities, or programs to work with diverse groups of people and equip students with strong content knowledge about social justice and diversity.

Yet, what is unclear in most of the studies and a gap that is not addressed is there appears to be a social structure in higher education where only certain areas or groups discuss social justice issues. Some students are privy and exposed to certain types of knowledge and some students are not. This leads to a larger question if advanced courses, content specific courses, or a curriculum geared towards social justice issues- are only certain majors, groups, or student privy to this exposure? This leads to an even larger question if social justice issues are a conversation that should only occur by those interested in the topic or if there is a larger university responsibility to see all students are involved and exposed to social justice issues.

Students that enter a STEM based higher education institution should be required to interact, discuss, and learn from students who are different from them through mandatory education and training on issues of race, ethnicity, religion, gender, and socioeconomic class. This way they are armed with the knowledge and information about diversity, multiculturalism, and are immediately exposed to difference. Students arrive on campus to earn a degree for a financially sound career, to become more educated in various areas, and to be exposed to ideas and lifestyles they may not be exposed to at home. Universities that take on addressing issues of

race, ethnicity, religion, and gender at the start of a college student's higher education experience perform a service to the student and society as a whole. It is not enough for universities to conduct studies or teach in pockets that only reach a small sample of the population. The university is a setting where all backgrounds, faiths, and lifestyles congregate in one setting and if a learning module can take advantage of this opportunity, there is potential for student growth beyond mere academics and career goals.

Students are responsive to courses and curriculum that address social justice issues and the responsibility rests on the university to teach and train students to be culturally competent citizens and leaders. Increasing enrollment of underrepresented groups does not address the core issues and finding relationships between the equality of race relations on campus and interactions with diverse student bodies should be a focus of universities. As higher educational institutions bring students of various racial, ethnic, and cultural dynamics together in meaningful ways, to engage in civil discourse, and to learn from one another by offering varying courses and a diverse curriculum that addresses social justice issues is key to broaden understanding and to the development of relationships.

As this conversation and discussion progresses, it is important to consider if social issues courses are necessary for STEM students? What is higher education's responsibility in promoting education and awareness towards social issues? Is it possible that through social issues and social justice courses where students examine racial and ethnic diversity necessary for student personal development? Are students able to recognize that global citizenship is dependent upon the experiences students have with diverse peers? Can students learn skills necessary for a fair and justice democratic society and see that consistency in a student's

exposure to experiences with multicultural educational programs as key components for student understanding of these issues?

Chapter 3: Methodology

Research Design

This two-month long intervention was an action research design study. There are multiple purposes of this study as it looked to design a prototype of a potential course and evaluated the effectiveness of the course on changing student beliefs and perceptions of social justice issues. In order to address these issues, I chose a qualitative research design with a survey using descriptive statistics so as to have rich and full data on the implementation and the student's experience of the effect of the course on their understanding and commitment to social justice as it relates to their chosen STEM fields. Figure 1 represents a chart that addresses each research question with the data collection methods that was used to address the questions.

Research Question	Data Collection Methods
How do STEM students, in the Honors College taking an STS course, perceive the relationship with STEM and social justice and social inequity?	Researcher Interview Reflection Responses Questionnaire Focus Groups
How do STEM students, in the Honors College taking an STS course, engage with the two month long intervention module and how are their observations, perceptions and experiences as a STEM student reflective in their discussions and understandings towards issues of inequity, diversity, and social justice?	Researcher Interview Reflection Responses Focus Groups
From the perspectives of the students and the researcher is there a change in STEM student's perceptions of social issues and social inequity after implementation of the two month long module in the STS Honors course?	Researcher Interview Reflection Responses Questionnaire Focus Groups

Figure 1: Research Questions and Data Collection Methods

Sample

The sample was a convenience sample taken from one STS 201 course in which there are 28 students. The sample population included STEM students in the Honors College taking an STS course and in majors from Biomedical Engineering, Biology, Computer Science, Information Technology, Physics, to name a few. The students were either in their first or second year at NJIT. Of the 28 students in the class, 13 were female and 15 were male. Most (if not all) of the students in the STS 201 declared a major in a STEM field.

Data Collection

Given this study focused of my own practice it was important to collect enough data and have different kinds of data to provide for the study's trustworthiness. I employed four data in this study as it involved the use of one researcher reflective interview, student interview notes and reflection responses, a questionnaire, and a focus group.

Researcher reflective interview. I recruited a professor from the department to conduct interviews of me. In these interviews, the interviewer asked questions of me that chronicle my thoughts, actions, and biases during the entire process. In addition, the interviewer asked questions that forced me to reflect on my observations, involvement, and that discussed the step by step process and how I viewed and experienced each learning module. Researcher reflective interviews allowed me, as the researcher, to document and analyze my views throughout the process of the study. It served as a place to highlight potential bias and chronicles how I viewed my actions during the process. A semi-structured interview guide is provided (Appendix D).

Interview notes and reflection responses. As part of their participation in the course students were asked to keep interview notes and write reflections on their experiences in the class. Interview notes provided rich, thick description and placed the student in the role of

observer. Interview notes asked students to engage with their observations and become fully involved with their setting. The interview notes were void of analysis, judgment, and opinion from the student. In the reflection essays (Appendix D) students considered what they learned and how it correlated with what they witness and experience in the field. Further, it asked them to reflect on their views, perceptions, and ideas prior to the learning module, during the module, and once the module is complete. The interview notes and reflection essay allowed for personal insight, examination, and understanding of a student's thoughts, ideas, and experiences. In addition, the reflection essay asked students to address in what ways and how their STEM field of study improved, enhanced, or solved issues they observed in their field of study. Both interview notes and reflection essays were collected on a voluntary basis after final grades were submitted for the course. The interview notes and reflections were part of the course assignments. The data collection of the assignments were part of the study. Students were given the option to opt out of allowing their responses to be used in the study. The interview notes had given me an insight to the student perspectives before and during the intervention module; while the reflection responses offered the potential to view any growth, change, or influence on the perceptions of students. The reflection response assignment is attached (Appendix D).

For data collection of student reflection responses, I asked permission of the student to use his or her reflection responses in the study. The request, collection, and use of reflection responses occurred after final grades were submitted and the semester was complete. I did not use student names or any specific identifiers except their age, gender, and major. Lastly, they were assigned a final reflection response and discussed their views as a STEM student as it pertained to issues of social justice and social inequity. Students were sent a consent form indicating their permission to us the reflection responses in the study, and were made aware that

it had no influence on their grade or course performance, and that the data remained confidential. The questions and assignment are included (Appendix C).

Questionnaire. I used Torres-Harding (2012) Social Justice Scale (Appendix A) as a model, revised it, and created a questionnaire that examined and evaluated student beliefs, perceptions, and ideas towards social justice issues. I created this questionnaire to suit the specific needs of this study. I added specific statements to the questionnaire to address specific content issues discussed in the intervention protocol regarding race, ethnicity, social justice, and social inequity and assessed student beliefs prior and following the intervention. (Appendix B). This questionnaire was distributed via email using Survey Monkey to students in the STS 201 course at the end of the intervention module, following the end of the course, the timely submission of grades, but prior to the focus group. In addition, there was an informed consent document that indicated this questionnaire is optional, voluntary, and posed no risk or effect on a student's individual grade in the course. All students who completed the questionnaire were asked to provide the signed consent.

The Social Justice Scale designed by Torres-Harding, Siers, & Olson (2012) is a 24-item scale that measures social justice perspectives. It consists of four subscales rated on a Likert scale from 1 (disagree strongly) to 7 (strongly agree) labeled as the following: 1) The Attitudes Towards Social Justice subscale, 2) the Perceived Behavioral Control, 3) the Subjective Norms subscale and 4) the Behavioral Intentions subscale. The goal of the Social Justice Scale is to better understand how attitudes in social justice lead to social action. Torres-Harding, Siers, & Olson (2012) administered the scale to undergraduates and graduate students at Roosevelt University in Chicago. They collected data in two phases: the first phase consisted of 115 undergraduate and graduate students, while the second phase consisted of 276 undergraduate and

graduate students. I chose this scale because Torres-Harding, Siers, & Olson (2012) argued that "the SJS itself does not measure behavioral performance, but rather assesses intentions to engage in social justice related behaviors, and can be used as a tool to link social justice-related attitudes and behavior" (Torres-Harding, Siers, & Olson, pg. 86, 2012). Therefore, one of the purposes of this questionnaire was to assess the intentions and engagement of students in the STS 201 class towards social justice and social inequity. Students had the option to opt out of the questionnaire. Further, due to restrictions from IRB because the course I studied was a course I taught, I did not administer a pre and post survey. This prevented any potential conflict of interests students may possibly have felt.

Focus group. The focus group provided qualitative data that explained broader interpretations of the questionnaire responses (Creswell, 2014). The focus group allowed for a sampling of a smaller group of the entire population and to obtain data that is personal, honest, and deeper when compared to a questionnaire, as well as, in-depth individualized, personal experiences that did not appear in the questionnaire (Creswell, 2013, 2014). The focus group utilized a semi-structured interview protocol comprised of a series of questions with probes (Appendix C). To develop this protocol I identified key topics and design questions around the themes that came up in the researcher interview, student reflection responses, and the questionnaire to accurately and thoroughly gather the experiences and perceptions of students in the course. The questions asked students to reflect on their experience, beliefs, and perceptions following their participation before and after the intervention protocol.

I created one focus group consisting of a maximum seven students. I sent an email to the class asking any student volunteers to participate in the focus group. As an incentive, I provided doughnuts for participation. Students were given a consent form indicating that participation is

strictly voluntary and it does not influence their course grade in any way. The focus group was recorded on my laptop and took approximately an hour. There were 5 focus group questions, one from each topic. The fifth question discussed STEM and its role in social justice and social inequity. Focus group questions are provided (Appendix B). Students participated in the focus group had the option to opt out if they no longer want to participate or if they changed his or her mind.

Role of the Researcher

Role of the instructor

The instructor's role in the intervention module was key for its operation and function. The instructor served multiple roles as a facilitator of discussion, an impartial observer and enhancer to discussion, as well as, creating a classroom environment that maximizes student learning, engagement, and effectiveness. An environment where desk placement, cell phone use, and limitation of computer use proved to be effective tools in creating an effective intervention module. As the instructor of the course it is important to be mindful of all perspectives, views, beliefs, and opinions. Because the classroom environment is set up in such a way that students are encourage to discuss their opinions and ideologies, the instructor must be aware of potential bias or influencing the conversation the steers too much in one particular direction.

Because the intervention module is something I designed based on my experiences teaching this course, I approach it from the perspective of marginalized groups and frame it around a conversation of social inequity. Since there is already an inherent bias in the topics I am presenting and even though the topics are current and topical, as the instructor I must be mindful that some students may not have, and may never will, an interest in these types of issues.

Facilitator of discussion. As the facilitator of the discussions, the course instructor's role was vital during class discussions. It was imperative that the course instructor created talking points and open ended questions that allow students to stay focused on the task (via talking points) and provided questions that allowed student exploration into their own thoughts and ideas. For examples, when discussing gender identity, one student held the belief that gender is binary and that one is either male or female. In contrast, another student argued that gender is non-binary, and that gender identity is something that is personal and specific to that particular individual. From this point, students were introduced to various bathroom bill legislations from Texas and North Carolina. And the conversation circled back on how socially, culturally, and personally we define gender as individuals and how gender, at times, is defined for us. The conversation evolved from two individuals with two distinct viewpoints to an entire class room conversation regarding gender, gender identity, and gender stereotypes. There was a free flowing conversation where students were provided an environment where they believed they could speak freely, honestly, and openly; discuss facts, perceptions, and develop broader understandings. This facilitation was bolstered by the instructor's strong attempts at impartiality, the position of desks, the placement of cell phones, and limited use of computers.

Impartiality. The key to a successful and robust discussion via this intervention module was the impartiality from the course instructor to the class. Upon review of my researcher reflection notes, the biggest challenge was to stay impartial when a student makes any claim or something that goes against what I believe both personally and professionally. However, throughout the intervention, I took note of those moments and how I responded. The important thing for me to consider were not my views/beliefs on the matter, but the student's. In my notes, I stated,

> It is very challenging to stand there stone faced and not react when a student makes a blatant generalization, not rooted in fact, and strictly on emotion or belief. Numerous times I could see a level of discomfort in some comments students make towards certain issues we covered. However, I do not shoot down their ideas, but rather remind students to provide supporting information. I remind students that rather than be offended by comments, let's ask questions, and try to get a better understanding of the individual's position. It is here where the dialogue and conversation grew.

Once students understood that their grade was not affected by their personal ideologies and that I, as the course instructor, was not going to judge their ideas and comments, but rather use them as a spring board to larger conversations, this established a clear, safe, and open classroom and learning environment. Students let their guard down and things they thought of in private, now became open for discussion and the learning via dialogue, conversation, and communication is apparent. This type of environment was created based solely on the impartiality of the course instructor. The classroom thus did not become a forum for an experienced educator who pontificated his or her views towards an array of subjects that he or she had potentially more experience or exposure to information towards. Rather, it became a lab, a lab of ideas, conversation, discussion, and attempts that dissected misunderstandings and created connections with individuals from diverse backgrounds, perspectives, and ways of seeing. This type of classroom environment rested solely on the shoulders of course instructor, and was enhanced by the instructor's arrangement of the desks, cell phone policy, and use of computers.

Position of desks. For this intervention module, the desks were placed in a "U shaped

and out of the traditional "teacher-centered" style (Figure 2). With a total of 28 students and 10 tables, each table with three chairs, students were teamed up in groups of three and one group of four. In analyzing the researcher reflective notes, I observed that students sit more attentively than the traditional rows. As they are speaking to one another, they had saw everyone of their classmates, scanned the class, and addressed everyone. There was a certain accountability students appeared to have, since they might believe they were being watched by their fellow students. The U-shaped set up allowed for more cross class larger group discussion, as a student from one side of the room with a varying opinion may unknowingly engage in debate and conversation with a student holding opposing views on the other side. A drawback was that students tended to sit with the same group of three every time in class. A consideration would be for the next study is to break up and not let the groups become cliques.

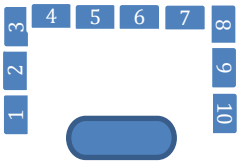


Figure 2. The U-shaped Position of Desks for the Intervention

Placement of cell phones. A key factor in the engagement and discussion portion of the discussion section of the intervention module was the placement of cell phone. I asked students to keep the ringers on silent and turn the cell phones over, placing them at the corner of their desks. I provided them a brief moment after every discussion point, to "check their phone" if necessary. This hoped to alleviate two main issues: 1) the desire of the student to focus more on what is (or is not) going on in their phone while class is going on and 2) allowed the student to focus on their classmate's speaking. By instituting cell phone rules, but one which allows a flexibility for students to access them, this potentially lessened the desire and urge for the student to see what is going on via the cell phone. I argue that for many of this generation's

undergraduates, the cell phone is an extension of themselves and their lives, so to strictly deny them cell phone use in class only hinders the amount of information they absorb. If they know they are allowed access to it, at certain times, and politely and respected use it, then it appears to be a stronger desire to engage in discussion.

Limited use of computers. Similarly, computers were not used in class. Students were sent audio and visual notes via email prior to the class. Part of homework was to go over the notes in preparation for the material. Computers were not needed when going over the articles or the notes, as they appeared on the screen in the class. However, computers were told to be brought in when I knew in advance I would ask students to provide information to support their views and beliefs.

Computers during the intervention were not needed for notes. The notes were sent to the class via email and the course homepage. Unless part of the assignment required students to utilize computers, for intervention purposes the computers were unnecessary and served as a distraction for students engaging in discussion. Thus, computers were not used during the intervention.

Intervention Module Design

The Science, Technology and Society (STS) program at NJIT offers students social science courses and provides a liberal education with a foundation in social science knowledge to NJIT students. One goal of the STS program is to encourage students to explore the impact science and technology has on our social, cultural, and political world. The NJIT course catalog describes the STS 201 course as,

> A problem-centered and task-oriented course that integrates social science theory and practice into the leading public issues of a technological society. Students learn critical

thinking through hands-on assignments. The course emphasizes student understanding of social institutions that directly affect technological development and professional careers. As an STS 201 lecturer for seven years, I have observed and taught students taking the course and these observations and pedagogy are the inspiration behind the creation of an intervention module.

Prior to the implementation of the module, the STS 201 course focused strictly on social science theory and the relationship to technology and a student's professional career focus. It was void of discussions regarding social inequality, race, sexual orientation, and social justice. As years passed teaching the course I noticed an uptick in negative rhetoric and perceptions towards various social groups in class conversations and discussions. Presumably, these perceptions came from numerous media outlets, "shares" and conversations via Facebook, tweets and retweets via Twitter, which seemed to fuel preconceived notions that students held towards individuals and groups different from them. As a university lecturer that interacts and engages with freshman, I felt it was my role as an educator to bring issues that address social inequality, race, and sexual orientation to the forefront of an STS 201 course and attempt to connect the issues to a NJIT student's STEM educational experience.

Through the years my subjective assessment was that a large percentage of students enter NJIT with low social awareness towards social justice issues and socioeconomic issues. In addition, I observed that many viewpoints are shaped by various forms of media they use (specific media outlets, new programs, websites, and online groups) or not shaped at all. One example was that students appeared to have limited knowledge on the effects that natural disasters have on lower socioeconomic groups and tend to hold preconceived notions regarding views on race, gender, and sexuality. For example, in response to lessons, readings, and

discussions that address the long and short term impact of natural disasters on a community such as New Orleans following Hurricane Katrina, students often stated that "they never knew a storm could cause so much damage beyond flooding" and failed to realize how negatively a storm impacts individuals from low socioeconomic areas. When discussing marriage equality freshman students are generally unaware of the 1996 Defense of Marriage Act and the 2015 Obergefell vs Hodges Supreme Court decision which legalized same sex marriage in all 50 states. In addition, students appear confused or lack the understanding of the distinction between the terms gender identity and sexuality identity. When addressing racial and religious bias, students often were shocked at laws such as "Stop and Frisk," "NSA surveillance," or the rise of white nationalism during the Obama years. And lastly, when the topic of food insecurity is broached, student perceptions of hunger is limited to commercials they see of starving children in underdeveloped countries. They generally lack awareness of issues such as food deserts in America and that every year more than 15.8 million households are food insecure in the United States (USDA, 2016).

High school students enter college from different regions of the country and from high schools with varying curriculum. As a result, it is difficult to ascertain the extent to which incoming freshman have been exposed to discussions, information, and engagement regarding socioeconomic inequality, race, gender, and sexual orientation. NJIT students are a diverse group and the school is consistently voted one of the most diverse campuses in the country. With over 7000 undergraduates from 33 states and 100 countries, the student population is one that varies in socioeconomic status, race, religion, ethnicity, and sexual orientation. Two thirds of the population at NJIT are male. While teaching this diverse group over the last six years I noticed that regardless a student's background, there appears to be limited awareness and understanding

from students, regardless of group, regarding social justice and issues related to race, ethnicity, sexuality, and gender identity. Their viewpoints and ideas are present, however, a discussion and engagement with these specific topics, actual events, and facts appear limited and that students have limited exposure towards.

Critical social dialogue (CSD) engages students in the processes of problem posing, facilitation of personal experience and dialogue, and requires students to re-examine their beliefs and perceptions towards social difference and social justice (Chavez-Reyes, 2012). The Contact Theory posits that face-to-face encounters with individuals from different groups effectively reduces inter-group tensions. It is through face-to-face encounters group members are likely to reduce prejudice compared to courses that do not encourage interaction (Allport, 1954). These ideas are supported by a wide range of research that focus on teaching and learning strategies to encounter racism and difference. In order to prepare students for our rapidly changing diverse society, students find discussion and interaction among their peers the most effective strategy in confronting and discussing highly sensitive topics such as race, sexuality, and difference (Jakubowsk, 2001). It is through dialogue that students are eager to engage in taboo topics, as well as, conceptualize the terms, theories, and ideas that appear in their textbooks. Conversations improve cultural competency, decreases prejudice, and expose students to varying perspectives towards social justice issues. Dialogue and engagement offers students the opportunity to learn beyond stereotypes, to see people as individuals, and to view others through a lens of patience, attentiveness, and caring (Harris, 2003; Stough-Hunter, 2016). Thus a curriculum that engages students in dialogue, face-to-face interaction, and expose students to individual experiences will result in a student more aware of the social, political, cultural, and economic contexts in which diverse individuals work and live (Chavez-Reyes, 2012; Jakubowski, 2001; Harris, 2003;

Stough-Hunter, 2016; Jordan et al., 2001). In turn, the student becomes more socially and cultural aware of others, and how personal, political, cultural, and religious beliefs shapes their own and other people's perceptions and values.

As a result I designed an intervention module that puts students to task on two critical fronts: conversation and engagement. As educators it is not enough to lecture, present information, and assess students. When students actively learn new material, interact with other perspectives, and engage with the community, the subject matter takes a life of its own and students become vested in the course and the subject matter. In turn, they have the opportunity to expand their social and critical awareness, as well as, their individual perspectives towards pertinent and critical societal issues. This is important for students in the STEM field, as this course and intervention module may be the only opportunity in which they discuss issues such as socioeconomic inequality, racism, sexism, sexuality, and social justice during their four years at NJIT and before they venture out into a STEM driven economy. Thus a main part of the intervention module includes Critical Social Dialogue (CSD) and the Contact Theory and requires student engagement and conversation with individuals and groups toward social justice issues.

Intervention Module

The intervention was an eight-week long module broken up into four two-week units with each week addressing a different topic framed around social justice and social inequity. The units consisted of a background lesson, discussion, a modeled activity, and protocol for conducting fieldwork in the first week. The second week saw students going outside of the classroom into the field and observing, participating, and analyzing examples that correspond to the week's material. Once they completed all four of their observations/fieldwork participation,

they submitted one follow up written assignment from the lens and perspective of a STEM student. They addressed how, if at all, their field of study in STEM helped enhance or expand the conversation of specific social and cultural issues. This was then followed by a questionnaire and a focus group.

The intervention module required students to evaluate their views on specific issues prior to performing fieldwork and requires them to revisit their initial views in a reflection essay to analyze if at all their perspectives have been influenced by the intervention module following its implementation. The ultimate goal of the intervention module was to assess student views of social justice issues and to discuss relevant and current issues related to social justice and inequality while providing them opportunities to engage hands on with fieldwork experience related to the issues.

With this intervention module, I evaluated STEM students' views on social issues and social inequity issues. Further, once the observations/fieldwork participation was completed, I was interested in knowing if students come to see a connection between social issues, their work as a STEM major, and the potential impact their work could have on specific issues related to social justice and social inequity. I was interested to see if, when using their STEM education lens, they provide possible suggestions or solutions to a common social inequity and social justice issues.

For example, during the intervention protocol students discussed issues such as socioeconomic issues related to natural events such as Hurricane Katrina and Superstorm Sandy; they evaluated institutional forms of discrimination such as NYPD's Stop and Frisk Policy, profiling with the NSA's Surveillance Program, and an overview of the Federal Hate Crime Statue; students discussed the 2015 Supreme Court's Marriage Equality Decision, Gender Bias,

and LGBTQ equality. Each of these examples on the surface appeared to affect a specific group, but specific questions and how the protocol was designed aims to show the universality of these issues and how it effects all of society as a whole on a day to day basis. Students were asked to evaluate their views on issues of race, inequality, and social justice; a reflection essay at the end of each week's fieldwork experience asked them to reflect on their experience and how it influenced their perspective; at the end of the final fieldwork experience students submitted one final essay discussing their experiences as a whole and how, if at all, their field of study as a STEM major can further enhance and improve conditions for specific people and subsequently, the global community.

Below is a breakdown of how the module operated weekly:

Week 1-2: Hurricanes and Social Inequality. When natural disasters strike more often than not those whose homes, lives, neighborhoods are destroyed are often forgotten under the major storyline of the event itself. This section introduced students to the human side of a hurricane and what happens to those who cannot afford proper shelter, who cannot leave their specific homes, and whose lives are destroyed and are unable to rebuild. After reading short stories and viewing mini-documentaries on personal accounts from these two experiences, students and the professor will design 5 questions to incorporate into a semi-structured interview protocol. Students partnered up and practiced the interviews on one another. Then the two partners will pick two areas of the region hit by Superstorm Sandy. They are asked to interview two individuals with the semi-structured interview protocol to discuss how Sandy impacted their day to day life. Students then discussed their respective interviews together and write up a reflection essay based on their experiences and their perspectives following the fieldwork assignment.

Week 3-4: LGTBQ Equality. Students discussed, evaluated, and analyzed the 2015 Marriage Equality Supreme Court decision. In the discussions that follow the class will be introduced to a brief history of the LGTBQ movement, LGTBQ inequality, and the struggles the LGTBQ community still faces in 2016. Further, the class will examine gender bias and how it plays out socially and culturally. Students will interview a member of the LGTBQ community or view the documentary "The Freedom to Marry." Students will submit a reflection essay based on their individual experiences and how, if at all, their views have been influenced they their fieldwork experience.

Week 5-6: Racial, Ethnic, and Religious Bias. Students discussed, evaluated, and analyzed NYPD's "Stop and Frisk Program" (2002-2013) under the Bloomberg Administration. They examined and analyzed the "Theory of Broken Windows." In addition, students will evaluate and discuss the NSA's Surveillance program, will examine the Federal Hate Crime Statues and examine implicit bias. Students will interview another student of a different race, ethnicity, or religion affiliation their own. Using questions designed by the class and the professor, students will conduct semi-structured interviews with another student. In their interviews students will ask questions and discuss sensitive issues related to race and ethnicity. They will submit a reflection based on their experiences and offer how, if at all their views have been changed from the interview activity.

Week 7-8: Sex and Gender. Students discussed, evaluated, and analyzed the main points from the 2015 PBS documentary titled "Growing Up Trans." Before and after the film we discussed issues such as sex, gender, gender identity, and sexual orientation. Students were asked to discuss their views, reactions, and ideas that come up in the documentary. Students then wrote up a reflection essay once their fieldwork is complete.

Final Reflection: After completion of all fieldwork assignments, students were asked to write one final reflection summarizing their experiences and views with the fieldwork assignments and the module. In addition, they are asked to incorporate their views as a STEM student and a specific STEM major. The assignment requests them to consider their role as a STEM student and if they see a potential way their specific field of study can enhance, improve, and/or benefit any one of these particular issues they experienced.

Questionnaire: A questionnaire was provided after final grades are submitted to evaluate student views, beliefs and perceptions regarding social justice issues following their interaction with the intervention protocol.

Focus Group: Students engaged in a focus groups. Approximately 7 students engaged in 1 focus group addressing social justice issues as it relates to the intervention. Below is the model of the intervention module featuring the topic, lesson, subjects covered, potential discussion questions, and post activity.

Week	Topic	Lesson/Questions discussed	Activity/Assignment	Activity Description
1-2	Hurricanes and Social Inequality	Discussion/short clips on a) Hurricane Katrina b) Superstorm Sandy And an overview and discussion of how these disasters caused, enhanced, and/or brought out socioeconomic inequality **Potential Questions** 1) In what ways do socioeconomic and cultural issues come to the forefront of a community during a natural disaster? 2) In your view, do you believe some people are more likely to survive a natural disaster because of who they are, where they	Interviews and Interview notes/Reflection write up	Students are to interview people impacted by Sandy and interview residents to gauge their experiences

		live, or their place in society? 3) Consider how global climate change effects poorer communities around the world. 4) Where does a STEM student fit in the climate change conversation?		
3-4	LGTBQ Equality	Discussion/facts/notes/history/current issues on: LGBTQ equality Marriage Equality **Potential Questions** 1) In what ways does the LGBTQ community experience discrimination, bias, and prejudice in 2017? 2) What are your views on marriage? In marriage a religious institution, a social institution a cultural institution, or an economic institution? Or is it not an institution at all?	Campus LGBTQ group meeting/Interview notes and Reflection Essay	Students are to interview a member of the LGBTQ community or view the documentary "The Freedom to Marry."
5-6	Racial/Ethnic/ Religious Bias	Discussion/facts/notes/brief overview of some racial/ethnic/religious conflicts NYPD's Stop and Frisk NSA Surveillance Federal Hate Crime Statues Xenophobia **Potential Questions** 1) What is implicit bias? 2) What are your views on profiling? 3) Do you believe hate crimes prevent crime? 4) What does xenophobia look like to you?	Interview Interview notes Assignment/Reflection writing up	Students will be paired up with someone who of a different race, ethnicity, or religious background and/or a religious lead to conducted interviews.

		5) Does STEM play a role in these categories, if at all?		
7-8	Sex and Gender	Discussion/facts/notes/statistics on sex and gender the United States Gender Gender roles Gender identity Transgender **Potential Questions** 1) Discuss your current views on gender and specifically gender roles as a STEM student. 2) What is gender identity and how do stereotypes and social norms influence gender identity?	Documentary: "Growing Up Trans," Interview notes and reflection write up	Students are to watch the documentary "Growing Up Trans", write and discuss.
Final Reflection Assignment:		**Assignment** Students are to write a brief (1000 word) follow up after they have completed the specific activity. In this follow up they are to discuss/address their observations and possible solutions to whatever issue, problem, or potential source of conflict through the lens of their respective field. The goal is for students to view the situation through the lens of a STEM student and offer suggestions and solutions on how to improve a particular situation through the scope of their specific field of study.		

Figure 3. Model of the intervention module

Data Analysis

Qualitative data analysis consisted of preparing and organizing the data, reducing the data into themes via coding, condensing the codes, and representing the data in figures (Creswell, 2014). I utilized the qualitative data (researcher reflective interviews, reflection essays, and a focus group) and analyzed the themes and relationships from the data of this study. I also used descriptive statistics to describe, compare, and analyze the results from the questionnaire. Data analysis for this study was broken up into five phases and an explanation of what took place in each phase is stated below.

Phase 1. Analysis of the data collection began immediately in Week 1 as the students handed in their reflection responses and I began the researcher reflective interview. Every week that a student reflection response was due it was immediately uploaded to Dedoose. At the end of every class, I returned to my office and conduct a researcher reflective interview. This interview discussed the class self-reflectively and addressed issues that arouse or things I would have done differently. At the conclusion of every week, I transcribed the audio from the researcher reflective interview into a Microsoft Word document and uploaded the document into Dedoose.

Phase 2. A pre-analysis of all the data compiled from the researcher reflective interview, student refection responses, and the questionnaire was done in Phase 2. When I received the returned questionnaires, I reviewed all the data from the researcher interviews, student reflection responses, and the questionnaires and weeded through the data and highlighted the main points in the data to which I used and created questions for the focus groups. I used the researcher interview, student reflection responses, and the questionnaire to design the focus group questions. The researcher reflective interviews were recorded and I composed analytical memos based on the topics and themes that come up during the interviews. The reflection responses were analyzed to examine student views and experiences before and after the intervention. The questionnaire and analysis of the questionnaire assessed student views and beliefs and determined if there was a change in student beliefs, perceptions, and engagement with social justice issues before and after the intervention module. These helped formulate the focus group questions.

Phase 3. After the focus group was complete I organized the data derived from the focus group. Since the focus group was audio recorded, I transcribed the data onto Microsoft Word and I uploaded it to Dedoose. At this point all the qualitative forms of data were uploaded onto

Dedoose and the focus groups and the data were organized, I conducted the main analysis and looked for themes and relationships across all data sets. I did not look at the data separately, but rather analyzed everything by looking across the data chronologically to see what story it told. I got a sense of the entire dataset and read the transcripts several times and immersed myself in the details of the student views and experiences with social issues. In addition, I memo'd and wrote notes in the margins of all the datasets. I looked for specific responses as it relates to social justice, STEM education, social issues and student experiences but remained open to responses I did not anticipate. This process was done at least three times before I went on to describe the data.

I then moved from reading and memoing the data to describing, classifying, and interpreting the data (Creswell, 2014). Through detailed descriptions I developed themes based from the literature, assumptions other studies have made, and topics from the intervention modules I designed. I looked for phrases and responses that addressed social justice, race, ethnicity, socioeconomic inequality, gender, and sexuality. I looked for information I expected to find before the study such as student views, beliefs, and experiences with social justice. In addition, I paid attention to information that I did not expect to find, attempted to avoid having tunnel vision, represented information that is interesting, unusual, or unanticipated by the researcher (Crewswell, 2013).

I coded the data, assigned labels to the codes, grouped the codes into themes or categories and divided the text of the data into smaller units; whether it was phrases, sentences, paragraphs, I assigned a label to the unit. I assigned baby codes to some codes that required more depth to them. I derived the following initial codes for research question 1: *perceptions, social justice, social inequity, relationship, STEM education*; I then came up with the following initial codes for

research question 2: *perceptions, engagement, intervention, learning module, reflection, experiences, discussion, understanding, social justice, social inequity, relationship, STEM education*; and I then I came up the initial codes for research question 3: *change, perceptions, engagement, intervention, learning module, implementation, experiences, conversation, influence social justice, social inequity, relationship, STEM education.*

After I coded, recoded, and baby coded, I created a general understanding and assessment of the data and gauged the perspectives and experiences of students with the intervention protocol. I then used excerpts of quotes, dialogues, and student narratives derived from all forms of the qualitative data and conveyed the varying perspectives and beliefs of student participants, what they took from the course, and how, if at all, their views towards social justice issues were influenced or changed by the intervention module (Creswell, 2013).

Phase Four. I coded one last time and broke down the larger codes and baby codes and established more detailed and specific categories that student responses fell under. These categories were derived based on student responses and further analysis of the data and to create specific larger headings and sub-headings. Specifically, I broke down the larger code of "awareness" into subcategories such as "content knowledge," "limited information and exposure," and "lack of awareness." The larger code for discussion was broken down sub-categories such as "influential," "informative," "pedagogy," "favorable vs unfavorable views," "face-to-face conversations," "relevance and irrelevance," "enhanced perspective," and "change vs no change."

Phase Five. For phase five I took the data from the survey, paired the before and after questions alongside each other, and analyzed the responses of students. With every paired "before" and "after" data set I used descriptive statistics to describe the data. These statistics were used to

describe, in general, if student understanding, views, and beliefs were changed following the intervention module.

Research Question	Data Collection Methods	Data Analysis Methods/Codes
Question 1. How do STEM students in the Honors College taking an STS course view and perceive issues of social justice, social inequity, and diversity. In addition, how do they perceive these specific issues and a relationship with STEM education?	Questionnaire Student Responses Focus Groups Researcher Interview	Dedoose Memoing, Coding, and Identifying Themes, and Relationships Among Categories Potential initial codes: *Views, perceptions, social justice, social inequity, relationship, STEM education*
Question 2. How do STEM students in the Honors College taking an STS course engage with the two month long intervention module and how are their observations, perceptions and experiences as a STEM student reflected in their discussions and understandings towards issues of inequity, diversity, and social justice?	Focus Groups Student Responses Researcher Interview	Dedoose Memoing, Coding, and Identifying Themes, and Relationships Among Categories Potential initial codes: *Views, perceptions, engagement, intervention, learning module, reflection, experiences, discussion, understanding, social justice, social inequity, relationship, STEM education*
Question 3. Is there a change in student's perceptions of inequity, diversity, and social justice after implementation of the two month long module in the STS course? And if so, do they see how their field of study as a STEM major can possibly influence conversations of inequity and social justice?	Questionnaire Focus Groups Student Responses Researcher Interview	Dedoose Memoing, Coding, and Identifying Themes, and Relationships Among Categories Potential initial codes: *Change, perceptions, engagement, intervention, learning module,*

		implementation, experiences, conversation, influence social justice, social inequity, relationship, STEM education

Figure 4. Data analysis structure

Chapter 4: Description of the Findings

The findings chapter is divided into two sections. In the first section, I discuss the findings of Research Question 2: "Student Engagement and Perceptions During the Intervention." It is in this section where I discuss the themes that arise primarily from the reflection essays. And in the second section I discuss the findings of Research Questions 1 and 3: "Student Perceptions and Beliefs Following the Intervention." Using the survey data, focus group, and reflection essay, I discuss the findings on student beliefs and perceptions following the intervention module.

Student Engagement and Perceptions During the Intervention

In this first section I discuss the findings on "Student Engagement and Perceptions During the Intervention." It is in this section where I discuss the numerous themes that arise from the data such as increased student knowledge and awareness and how both large discussion classes and face-to-face conversations are a vital pedagogical tool.

Many students in the STS 201 course stated in their reflection responses that increased knowledge and awareness was tied to content material. The content material for the intervention came from class notes, notes were derived from the text, and numerous articles and short documentary clips via online sources. The news articles were posted on the course homepage and students were assigned homework to both read the articles and view the clips. Once in class, the same articles were shown on a large screen and excerpts of the clips were highlighted to spearhead discussion and conversation, and to draw questions. Many students in the course expressed a positive reaction to the reading material and viewing the clips that supported the assigned readings. Some students in the course discussed their views of social issues prior to viewing the reading material and video content. Most of the responses focused on a brief

reflection from the students about how the material changed their point of view or understanding towards the issues. The study saw increased awareness, the influential power of discussion, and the importance of face-to-face conversations as just some of the more significant findings.

Content knowledge awareness

The content provided students a new perspective on issues they only had superficial knowledge of or with experiences in events, like Superstorm Sandy, but demonstrated that students were unaware as to the effect on other communities outside of their own neighborhoods. The articles and videos provided students a literary and visual experience into the realities of events they were disconnected from and of which they had limited knowledge. In turn, the readings and the videos allowed students to visualize and contextualize the events and attempted to provide a robust understanding of the event from various perspectives and experiences. As a freshman, female engineering student stated,

> Hurricanes Irene and Sandy did not shape the way I see the world, as I was in a far better position than most people; however, reading related articles and being exposed to the fact that these storms were devastating to others when they were simply annoying to me definitely changed the way I see the world, and I am now more aware of this disconnect and its local and global implications regarding social and class issues.

Students' responses to the content was overall positive and the content furthered student understanding towards social issues. Evaluating and examining the content forced students in the course to reevaluate and reexamine their own understandings and lack of knowledge towards social issues. As you can see in the above quote, this student acknowledged that even though she lived through the storm, it took reading about other people's experiences to realize its impact. Some students in the course expressed a newfound interest in the content or, at the very least,

were now more aware of issues raised in the content, and were more cognizant of the events that surround them, specifically those that did not directly affect them.

> Besides gaining knowledge and seeing new perspectives on the issues, I also feel as though I became a bit more interested in social issues. I never really cared about too many social issues before this class, since many of them don't really apply to me. As a middle class white male, I have never felt the need to worry about racism, socioeconomic inequality, gender issues, or same-sex marriage, as the statuses of these issues wouldn't affect me personally. However, now I have started to pay more attention to social movements and other problems that I see around me…I will definitely pay more attention to them and go out of my way to become more knowledgeable about them.

This particular student was a sophomore, male engineering student and acknowledged that because of his socioeconomic class and race, issues such as race, gender, socioeconomic inequality, and sexual orientation were not necessarily issues that were of importance or significance to him. But after reading, viewing, and discussing these issues, it appeared the module opened this particular student's eyes to experiences and issues outside of his specific demographic. This was important because one can argue it was not that some students were indifferent to certain issues, but rather the lack of experience and education towards these issues was potentially generated by a lack of exposure to the issues that are introduced.

Students in the STS 201 course that participated in the intervention module showed an increased sense of knowledge, understanding, and awareness towards social issues such as socioeconomic inequality, race, gender, and marriage equality. Of the students that took the survey, more than half "strongly agree" (60%) that their level of awareness increased and approximately one third (35%) "agree," while a small percentage (5%) remained neutral. The

data suggested the articles, video clips, discussion and reader responses assigned in the module helped increase overall student awareness. No student “disagreed” or “strongly disagreed” to this question. This potentially highlighted the effectiveness of the course as a method to increase student knowledge, understanding, and awareness of social issues (See Figure 5).

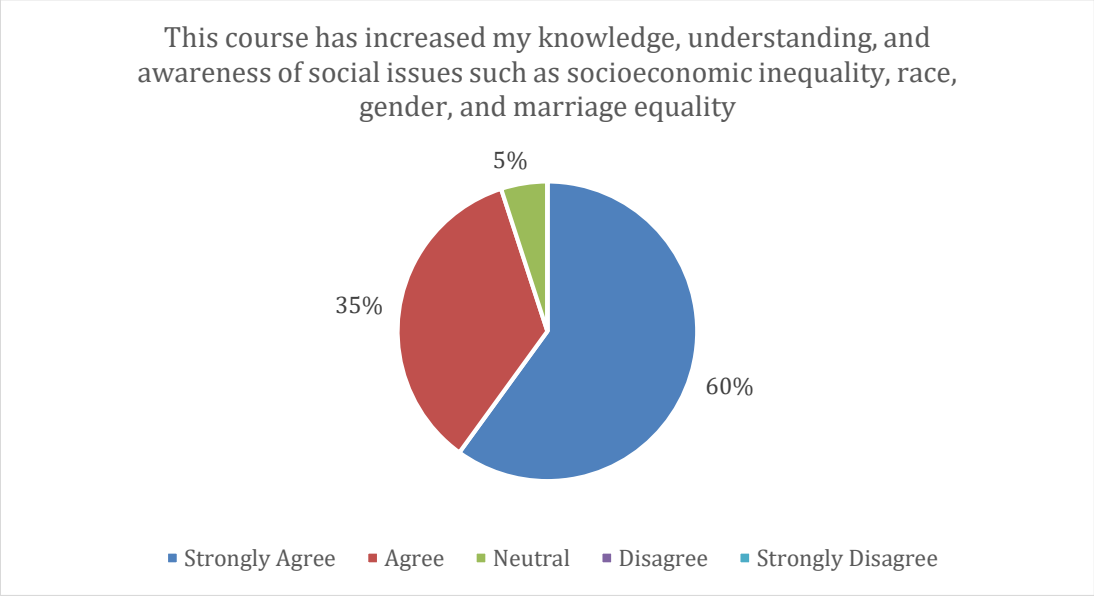


Figure 5. Increase of student knowledge, understanding, and awareness

As shown below in Figure 6, discussion among fellow students in the STS 201 course assisted in student understanding on the topics and issues covered in the course. Students wanted to hear from their peers, they wanted to know what and how they are thinking. An overwhelming majority of students either “strongly agree” or “agree” with the statement that the course helped them with discussing and understanding social issues, specifically with people who hold different views. As a result, students increased their awareness of another person’s perspective and had the opportunity to analyze and articulate their own views. This exercise proved to be an effective pedagogical strategy, as students were introduced to content knowledge they had a superficial understanding of and took the information given and discussed their views and understandings with their peers.

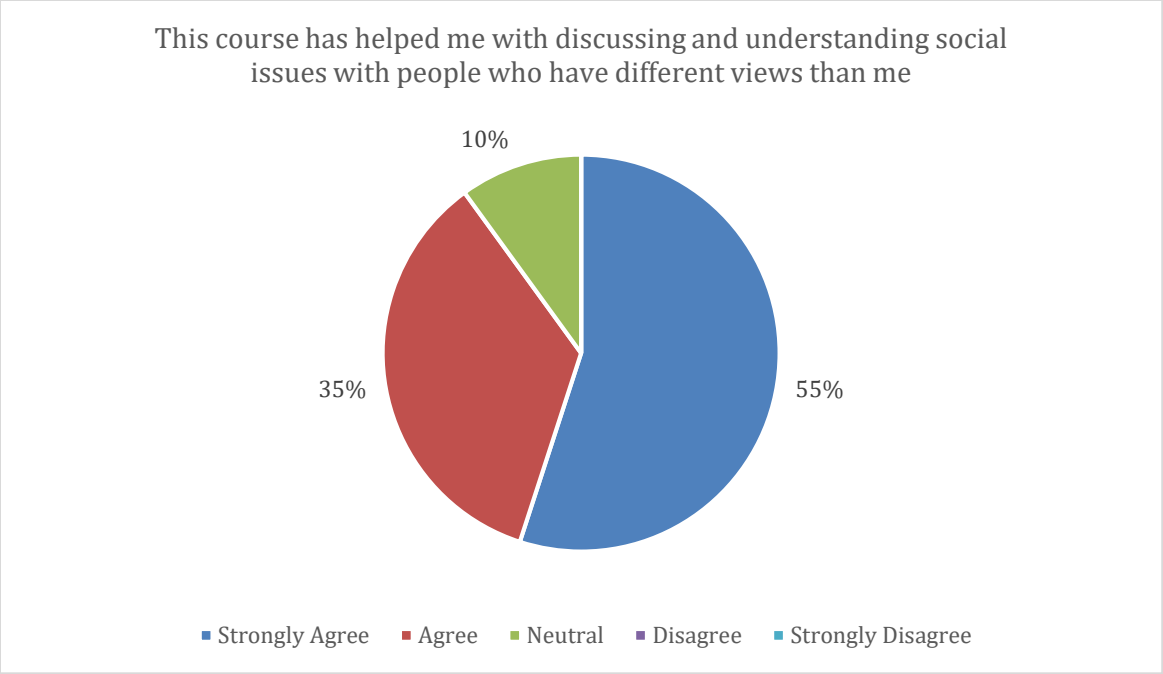


Figure 6. Student course views on discussion and understanding of social issues

Discussions: influential and informative

The overall effectiveness and positive feedback regarding discussions was another key and significant finding of this study. The majority of students in the STS 201 course found that discussion and talking amongst their peers of similar and different perspectives advanced their own understanding and increased awareness of social issues. Students in the study agreed they benefited most from the discussions in the course, in part because discussions helped students to understand where the other person was coming from and to learn about a different perspective. Despite positive views towards the documentaries and the readings, the discussions and interviews proved to be an effective tool in understanding perspectives, backgrounds, and experiences. When students engaged in critical social dialogue in the form of discussions, their awareness and engagement increased. They were provided an opportunity learn about another student's perspective by listening and engaging in conversation. Throughout the study, students commented how this exercise was key to their learning and understanding of not only the issue

but of broader perspectives. Critical social dialogue helped students potentially change how they look at a particular issue and allowed them to reevaluate their views and beliefs on an issue.

Awareness and engagement increased

Students believed the discussions increased their level of awareness towards specific subject matter and increased their level of compassion and understanding towards groups different from them. There was the element of both listening and talking that is an educational process. Students found value in hearing perspectives outside of their own, as discussions in the STS 201 course provided them with multiple perspectives. Students expressed that they are unaware, unprepared, or lack the knowledge of the issues discussed. Some stated that they knew of the issues, but not so much about details and an in-depth exploration of them. Students cited the importance of class discussions and conversations as stepping stones towards their own understanding and greater awareness of the issues, as the discussions allowed students to look at topics from various angles and listen to other perspectives. A female, sophomore engineering student stated,

> Learning about topics we have covered in class have not necessarily changed my opinions about social issues. Instead, these lessons and discussions have begun to shape my view on old social issues and new ones social issues that come up. They allow me to consider these topics in a different light and think about it from many angles. Basically, because of the discussions, I am able to hear other perspectives, while also being able to engage in a back and forth educated conversation about whatever topic we are discussing.

Another student, a freshman, male engineering major, saw discussions as a means to understand the other side. However, he also used it as a way to confirm his own beliefs. Thus for this particular student, he listened and engaged with varying points of view, but ultimately

walked away from the conversation confident in his own beliefs and values. The discussions for this student did not necessarily change his perspectives, but rather reaffirmed his positions. He stated:

> Learning and talking about these issues gave me a more complete understanding of them. To be willing to hear from the other side of an issue, and then to actually listen to their position are two aspects of society that I feel have been lost as people have become increasingly polarized to one side or the other. Through the conversations in and out of class about social issues such as gender roles and racism, I have been able to gain that understanding of the other side, and on that basis, I can confirm my beliefs.

Some students' perspectives and beliefs did not necessarily change as product of the discussions. Rather, the discussion, as expressed by the student above, helped them understand their own positions, while learning how other people viewed a similar issue differently. This in and of itself was a learning process and an example of increased awareness on two fronts: the student was more aware of his or her position, while the student was also introduced to a brand new perspective on a particular issue.

Discussion and pedagogy

The class discussions were an effective educational exercise and learning experience for students. Many students believed that the different points of view and arguments from varying perspectives served as a positive and engaging learning experience. One sophomore, male engineering student stated that, "even those students with opposing viewpoints still forced me to reflect on the reasons why I believe in what I believe."

Similar to the student quote above, the discussions seemed to naturally take students on a journey of personal self-reflection and evaluations of one's own thoughts, words, and perspectives:

> Before this class, I knew about all of these social issues, just not as in depth, but still enough to formulate an informed opinion. What changed me as a person were the in-class discussions that we had. From them, I was able to hear different viewpoints and arguments from a diverse group of people. Some of their view points were the opposite of mine which made me think about why I felt the way I did on these issues.

The discussions provided students with various points of views and perspectives which many say they had never considered. The study found overwhelming student support for class discussions as a gateway to further understanding of themselves, the issues, and each other. In addition, students found the conversations helpful in linking their ideas with the broader subject matter. As a freshman, female biology student stated:

> Our class conversations have shown me that there are multiple points of view, more than I even imagined. Additionally, I didn't think that there would be a connection between what seemed to be two random different topics. I learned that I need to have a broader outlook on life because, in a way, things that seem to be on the opposite ends of a spectrum can still be connected.

Students frequently stated in their responses that they never before viewed a particular issue similar to how another student saw it; or they did not think in the manner in which another student thought. At no point in the intervention module did any student say one viewpoint was more correct than the other. Rather, for the students, it was an enlightening, educational, and eye-opening experience that someone such as their peer, studying at the same university, at times

the same major, and sometimes with the same social circle, had vastly differing viewpoints and perspectives. It appeared the learning experience did not rest in the content, as much as it rested in student realization of the similarities and differences that existed among their fellow peers.

There was a general consensus among students in the STS 201 course that they learned a lot more in the discussions about the other side and engaged in the act of listening. Talking was important to them and it was through conversation in a large class setting where they learned about how different individuals interpreted and were affected by the social issue. Again, the discussions, as stated previously, gave students the opportunity to evaluate and examine their individual beliefs. A freshman, male engineering student stated,

> Learning and talking about these issues gave me a more complete understanding of them. To be willing to hear from the other side of an issue, and then to actually listen to their position are two aspects of society that I feel have been lost as people have become increasingly polarized to one side or the other. Through the conversations in and out of class about social issues such as gender roles and racism, I have been able to gain that understanding of the other side, and on that basis, I can confirm my beliefs. I will not deny that I learned a lot about these and other issues, but some of the discussions only reaffirmed my beliefs that a few of the issues should not be regarded as highly as they are.

Students saw the discussions as an opportunity to sift through their own mind and thoughts and examine what exactly they believed versus what they were taught or accepted without questioning. This particular student a sophomore, male physics major, believed that the conversations allowed for the opportunity to dismantle “fake thoughts,” the ideas and beliefs he obtained from talking with family or friends, reading a newspaper, or listening to a podcast. This

was significant because the discussions allowed students to create their own perspectives and views, based on their own understanding and beliefs and not one that was created for them or pressed upon them.

> All the topics we discussed throughout the course were issues I had heard or read about before. However, I came to realize that my thoughts and positions were mostly superficial and they lacked any sort of strong foundation. In fact, many of my ideas turned out to be not even mine, probably taken from a random conversation with a friend or family member, read in a newspaper article or listened in a radio podcast. Slowly but surely, our lectures and discussions allowed me to dismantle these "fake thoughts."

Discussions allowed students to understand their own individual points of view and better grasp knowledge of the content and material and how it related to their place in the world. Students appeared to use their experiences with the discussions and conversations as an opportunity to reflect on their individual thoughts and positions on various subject matters. One student, a sophomore, male computer science major saw the value of discussion, as it was the only time he ever engaged in conversations with people outside of his social group. This student expressed that most of his conversations and communications with people occur within his own social group, and as a result, since everyone had the same interests and point of view, the ideas, logic, and arguments often were similar, so there was no dissent or varying perspective, thus the awareness and breadth of conversation was limited.

> From them, I was able to hear different viewpoints and arguments from a diverse group of people. Some of their view points were the opposite of mine which made me think about why I felt the way I did on these issues. Growing up in high school, we did not have a class where we discussed social issues and researched them in depth. The only

> time I talked about social issues was with my family or close friends, but because I surrounded myself with people who were similar to me and had the same interests, our opinions on these topics lined up most of the time.

The same student addressed a key point in what makes the discussion so influential for some. This student found value in challenging one's opinions, as it forced individuals to support and logically rationalize why they viewed the particular issue in the manner they do. This student believed that when they heard the voice of a contemporary and when it was in a face-to-face setting, the person was confronted with the challenge of looking directly at the person whom he or she was speaking to. They engaged in the basic human function of face-to-face, social interaction and this simple exercise, where they heard a person's tone of voice, saw their body language, and were engaged with them one-on-one, had a greater personal impact to the student:

> When you have an opinion and no one challenges it, you do not need to think about why you have it. When people challenge it, you have to be able to back your opinion up and think about why you feel the way you do and is it for the right reasons. Being able to hear someone else's view point coming directly from them in person has a completely different affect than reading it online or hearing it from what other people say about that person. When opinions that oppose yours are heard via hearsay or online, you tend to just ignore or dismiss them if you do not agree with them. In person, it is hard to just dismiss ideas because you can see the person's facial expressions and hear their tone of voice as they speak which for me, makes their opinion have a greater impact and more valid. From these in class discussions, I have reconsidered many opinions I have and thought about why I feel the way I do and does it make sense to feel that way.

These conversations allowed students to unpack their mind and weed out the ideas that they felt did not belong and ultimately allowed them to create their own opinions. The in-class discussions afforded students an opportunity that some stated they lacked in high school. Specifically, the chance to engage in a class with controversial topics, the opportunity to engage in face-to-face discussion with a peer; these conversations differed than their frequent engagement online, as they were confronted with another individual's face-to-face expressions and tone of their voice. This made the conversation more personal compared to one behind a screen. Students began to consider how the other person might view a situation and are removed from their own individual perspective.

"Unfavorable" discussions

Much of the findings for this study focused on the effectiveness and power of discussion and conversation as an important pedagogical tool. However, not all students in the STS 201 course viewed the class, the content, and the instruction favorably. Of the 28 students who took the course and submitted their reader responses, four students claimed that courses such as this are filler and did not serve a purpose in a STEM institution and program. While others firmly believed that courses that address social issues and the social sciences, such as the STS 201 course, are not required or needed at a STEM institution. For some, the course did not leave an impact and though they see the course as a fun experience, they argued that they have nothing to take with them beyond the classroom and into their field of work. Some students were adamant in their views and beliefs and were encouraged by hearing other perspectives, however their views were not swayed from listening to another side of an argument. A freshman, female engineering student stated,

> I had my set opinions when coming into the class, and they were only changed ever so slightly with the discussion of my peers. I feel it is the same for most of them. Their opinions did not change drastically for the majority from their initial thoughts, no matter what they wrote in their essays. The discussions prompted conversation as to why each person thought their view to be true, but at the end of every question answered, not one person seemed to back down entirely from their original view. Because of this, I do not think a discussion oriented class is needed for STEM students, because they are adamant and care more about major related courses than the views of others that conflict with theirs. In the future, such discussions in the work place will be source of small talk, because the coming generation is more liberal with acceptance of differences and [most] are too lazy to stir up trouble with an indirect disagreeing view.

This quote was significant on many levels, as this student assumed all students in the STS 201 course did not change their views as a result of the reflective essays. Students were not given access to their peers' essays so I was uncertain how she drew this conclusion. She did argue that most of the students, when discussing, "did not back down from their original view." This may be true and an examination of my interview notes did confirm that most students did not change their view *in* class. However, it is in the reader responses where many students shared how discussions forced them to reexamine and reevaluate their perspectives *following* the conversations. This particular student argued a point shared by some students entering the class, "I do not think a discussion oriented class is needed for STEM students because they are adamant and care more about major related courses than the views of others." This statement was reflective of a general sentiment expressed by STEM students at NJIT: they were here to get a

STEM degree, to prepare for the global workforce, and discussion of social and cultural issues was not why they enrolled at NJIT.

Face-to-face conversations

The intervention module drew attention to face-to-face conversations as a transformative learning tool for students. In one module task, students interviewed family members, friends, or members of the community to ascertain their views on issues discussed in class. Overall, students provided positive feedback on this experience as they claimed the exercise of meeting, speaking with others, and addressing topics with varying viewpoints gave students new perspectives aided in their understanding of the nuances of the topic. Overall, the student responses were an effective pedagogical tool to engage themselves with the topic, while gathering other points of view and learning about different aspects of certain individuals.

Enhanced perspective and awareness

These interviews and conversations heavily influenced student perspectives. The interview process was influential on student perspectives towards topics, as well as how individuals of similar and different backgrounds viewed issues and topics differently. For example, during our discussion on race and ethnicity, students interviewed an individual of a perceived apparent difference (e.g. race, ethnicity, religion). Students shared that this exercise allowed them to see another person's point of view and their perspective of race from the eyes of someone who was of a perceived difference from them. In addition, the introduction of a new perspective naturally forced students in the course to reflect on his or her own understandings of race and of the issues discussed. As a freshman, engineering major stated:

> This conversation allowed me to see another side of someone's (specifically a white person's) experience. It was somewhat strange to hear how race and the concept is not

> much of a big deal in his life. While in my life, even though I grew up in a very diverse town, my skin color is one of the biggest defining features about me to a lot of people who do not know me and even those who do know me, but not that well.

The interviews allowed students in the course to explore their own preconceived notions and perspectives regarding the nuances of the topics and issues covered in class. Some students, such as the one quoted above, discussed the effectiveness of the interview process in helping them better understand complicated topics and issues such as race and bias, while having a conversation with individuals that have either similar or varying ideas. The following quote was from a sophomore, male engineering student who sees the conversations as a helpful tool to breakdown and analyze individual reasons why people discriminate and why they are prejudice. Further, the conversations helped this particular student understand that issues such as bias can be addressed and discussed, however the student also acknowledged the difficulties that exist due to human beings' instinctual nature to gravitate more towards people like them:

> My conversation with him has helped me to understand some of the reasons behind why discrimination and prejudice still exist today and how discrimination can cause more discrimination and that it is not one sided. It also helped to me to understand that although bias can be overcome by people that it is hard to do, due to our natural instincts.

The overall response to the conversations was very positive. Students had the opportunity to discuss issues with individuals they normally would not. They engaged in conversation and dialogue and saw the experience as a learning process towards better understanding of the topic, issues, and how people viewed them. Further, the interview process allowed students to make connections from the conversation into aspects of his or her own life outside of the individual interview. Students made connections to their own social upbringing and to a larger

understanding of their parents' experiences and, for some, their own religious upbringing. This student, a freshman, female biology student, drew connections from a conversation with a friend as to a tool to break barriers that come in the way of mutual understanding. This realization spread to aspects of her own life that she, until the module, failed to make connections with.

> Getting to know one another is one of the most obvious yet overlooked ways to break boundaries between one and the perceived other. I saw this trend not only in my conversation with Conrad, but in my parents' experiences in the workplace, and even in my own religious teachings.

While another student, a freshman, female art and technology major stated,

> I decided to start a group conversation rather than just one interview, instead focusing on the myriad of viewpoints present in the friend group that I have spent the last few months with. And I'll be very honest, there was a lot of arguing, but being more comfortable with each other and the depth that we went was fascinating.

This student took it upon herself to create her own discussion group outside of class, based on topics and issues discussed in class. In this group the student took the format, structure, and protocol of the classroom discussions and experienced similar results as we do in class. She cited arguing, but also the level of importance placed on comfort allowed the students to explore these topics in depth with one another.

Some students in the course noted a raised level of awareness and, in some cases, increased compassion towards those different from them. The interview process changed some student perspectives towards individuals, groups, and events they were disconnected from a knowledge base (aware of events that took place and what occurred), but it also struck a chord with some students on a deep, personal level. Some students took the issues discussed and

internalized it, and almost felt a sense of guilt for not knowing and for not having more compassion towards the affected groups. As a sophomore, female engineering student stated,

> Although the documentaries and articles gave me an awareness on what happened, the interview I had with my friends increased my understanding in a different manner. The interview allowed me to directly feel compassion towards someone who was involved. The interview changed my perspective and made the disaster of Superstorm Sandy more personal, even though I wasn't directly impacted.

The face-to-face conversations served as two learning experiences: 1) the student was provided the opportunity to learn about his or her interviewee in a way they previously did not know and 2) the student learned more about his or herself in a manner that they did not know previously existed.

The face-to-face conversations with other individuals was a tool in the module that was very effective and personal for the students. Based on student comments, the conversations took students out of their own personal and social bubble and re-introduced them to people they knew, but whose perspectives they never thought about or investigated. This finding highlighted the importance of a simple activity such as face-to-face conversation. The conversations were not held via text or email. Students saw the emotion on people's faces, heard the tone of inflection in their voice. They made the assignment about the other person, and as a result, the assignment and the conversation forced the student to reevaluate and to rethink their own personal views.

Student Perceptions and Beliefs Following the Intervention

Following the conclusion of the intervention module, I sent out a 25-question survey to the students. Of the 28 students who participated in the intervention module, 20 responded to the survey. Due to IRB requirements, the before/after questions were answered in the same sitting.

Thus the students at the end of the intervention module were asked to recall their views from a few months ago prior to the start of the intervention module. In this section, I discuss the results from the data, based on the "before" questions, in which students were asked to reflect on their views prior to entering the class on topics such as natural disasters, race, ethnicity, gender, and marriage equality, and questions that focus on a STEM student's views towards social issues. These surveys offered a small glimpse into student beliefs and measured to what extent students held a basic understanding of terms regarding topics and issues that are current, relevant, and prevalent. The surveys attempted to gauge the basic understanding of students on these topics. Thus, the findings present a general understanding as to student perspectives on topics the course covers and that directly relate to groups and social justice issues prior to the start of the intervention module.

Learning about social issues

After participating in the intervention module, many students in the study shared that they now saw a value in learning about social issues and the social sciences and consider it an important aspect of their academic experience. Students cited exposure to content in the STS 201 course and material prepared them for work on a larger scale. Some students acknowledged that the course allowed them to see things from different perspectives and understand those that held varying viewpoints. This skill was necessary and was a requirement for when they begin work out in the field. A sophomore, female computer science major stated,

> If a computer programmer thinks that he or she does not need to learn about transgender and homosexuality, for example, because he or she will be spending all of his or her time in front of a computer, then he or she will likely be caught off guard when he or she recognize the impact that these social issues have on his or her job.

Students addressed the importance to learning about social issues and social justice issues when interacting with individuals of different races, gender identities, and socioeconomic backgrounds as an important tool to have in the workplace. Since a STEM-based curriculum forced students to look at the world through a scientific and technological lens, then social science and social justice courses gave them an opportunity to look at issues outside of their field from a different lens, and one that potentially improved their social and cultural understanding and interaction. A 20-year-old female dental student added,

> Thus, the social sciences are extremely beneficial and should be mandatory for everyone, especially STEM students. Some argue that an engineer doesn't need to learn about current events and social issues, but what's the point of having an engineer who knows nothing about the world he or she is living in. Not only that, but I think the open discussion about topics like racism and gender inequality fosters open-minded people. I truly believe that the people who can make great impacts in the world are those with open minds and hearts free of hatred.

And a 19-year-old female student stated,

> Social science courses should continue to be taught at NJIT. The social science courses teach what classes such as chemistry and math cannot; there is no point learning how to create positive contributions to society if we are unable to communicate and show compassion to those we are trying to benefit.

These students expressed a positive view towards taking an STS 201 course. They believed that part of being a STEM major is to positively and effectively contribute to our society and STEM was a tool that helps bridge understandings. Students in the course appeared to appreciate the education they received outside of their STEM major and that potential it

offered to make them a well-rounded and a more effective citizen. Students drew connections between their understandings of other social groups and their effectiveness in using their degree to better the world. For these students the course fostered open-mindedness, creativity, and compassion and can potentially spread into the STEM major and career choice.

Limited information and exposure

Throughout the study, students voiced their perspectives and understanding towards social inequality and social justice issues. Students acknowledged they do not fully grasp particular social justice issues and the impact these issues have on communities, the environment, groups, and individuals. As a sophomore, male engineering student stated,

> All the topics we discussed throughout the course were issues I had heard or read about before. However, I came to realize that my thoughts and positions were mostly superficial and they lacked any sort of strong foundation.

Many students in the STS 201 Honors class stated they lacked prior knowledge entering the class towards issues of social inequality that follow natural disasters, same-sex marriage and gender equality, and issues that involve racism and discrimination. This lack of knowledge stemmed mainly from minimal prior exposure in high school. It appeared at the beginning of the intervention module, students in the STS 201 course were confident and comfortable in either what they know or what they do not know. Based on the reader responses and the findings from the survey data, student understanding appeared not grounded in data or facts, but opinions, beliefs, and socialization.

Lack of awareness

Students in the STS 201 course frequently stated in the study that they lacked awareness towards the issues we covered in class. Their reasons varied. Some stated that they did not pay

attention to issues outside of their social lens and scope, while others discussed not being interested or caring for what happened in environments other than their own. Students argued they lacked the knowledge and/or exposure to these issues prior to viewing specific clips, reading certain articles, and discussions with their peers. As another sophomore, male engineering student added,

> In fact, many of my ideas turned out to be not even mine, probably taken from a random conversation with a friend or family member, read in a newspaper article or listened in a radio podcast.

Often, students claimed they were unaware of such inequality and did not ever think about it because it did not affect them. Further, some students believed that it was not until reading the articles and watching videos related to the articles that they developed an increased understanding of another person's experiences. In addition, they unapologetically discussed their ignorance, as it pertained to issues that do not affect them. If it did not occur in their immediate community or directly impacted them, then, for the most part, students said they are unaware, not concerned, or limited in their knowledge and awareness towards specific events. As a sophomore, male biology student shared this sentiment:

> Prior to reading in depth about natural disasters and viewing clips, I had always thought of these disasters as sad occurrences, unable to grasp the sheer intensity and pain. I could only view these events as isolated outbursts of Mother Nature. They did not affect me, and I could not empathize much.

To further support the claims that students lacked of awareness towards social issues if it did not immediately affect them, some students stated they 1) didn't have the time to keep up with what's going on with social justice, 2) never paid attention to events involving social

justice, 3) had preconceived notions as to what they define is the reality of the situation, or 4) never made the connection of how social justice issues impact various parts of the community and society. A freshman, female engineering student continued,

> Prior to viewing the clips and reading the articles about natural disasters, I did not spend much time thinking about natural disasters. Having experienced Hurricane Sandy so close to home forced me to pay attention to it, but even though I knew there was a lot of devastation caused by Sandy, I did not make connections between a disaster like Sandy to the socioeconomic conditions of certain communities. I had not really thought about the effects of Sandy on poorer communities, I just focused on what was happening in my community and what was being talked about on the news.

A common theme among the students was that prior to reading articles and viewing clips, students failed to grasp the scope and range that some natural disasters had on a community. Even with an experience like Superstorm Sandy, students focused strictly on their own community and did not pay much attention to what occurred in a town next door. In addition, students failed to make connections between a person's socioeconomic status and their ability to successfully survive through a storm or not. Once students engaged with the material and saw the range of effects on various communities, they began to make a distinction between the ability of some groups of individuals to handle and prepare for a storm versus those who are unable to do so.

Relevance towards STEM education

Prior to entering the class many students did not associate social justice issues and STEM education. Some students failed to see a connection between social justice issues and STEM education, but a number of students believed the course was an important experience for them

personally and professionally. Courses such as STS 201 introduced students to real world issues that they may not necessarily had the time or interest in. In addition, the STS 201 course heightened awareness of some who now saw the responsibility they have as an engineer to provide strong infrastructure to the entire community, regardless of race, class, and socioeconomic status. As a sophomore, male civil engineering major stated,

> As a civil engineer major, I realize that my responsibility as a future civil engineer is to be able to create facilities for others no matter what their social status is. I have to put everything aside, including all the biases I have towards certain groups of people so that I can work towards building better infrastructure for ALL of the American people. If I am working in a community that does not have much money, I would have to come up with creative ways to improve the community using the resources that they already have. Civil engineering is such a broad field of engineering. I just want to be able to be a small part of it so that I can civilly work for the common good and put a smile on someone's face.

Some students claimed STEM students should learn about social issues that impact them and the world around them. There appeared to be an increased understanding and a dismissal of the stereotype that STEM students need not know about issues such as gender or sexuality. A freshman, male information technology major stated,

> Some areas of STEM will have more direct interactions with these issues, so these specific students should be prepared to handle them. But for those students whose industries have only indirect contact with these issues must stay informed as well, because these issues will shape the world at large to which they are catering their services. If a computer programmer thinks that he or she does not need to learn about transgender and homosexuality, for example, because he or she will be spending all of his

> or her time in front of a computer, then he or she will likely be caught off guard when he or she recognize the impact that these social issues have on his or her job.

This same student went on to say the importance of STS courses in nurturing and creating new perspectives for students to consider. The STS course allowed students to freely engage with other comments and viewpoints and gave the student time to reflect on his or her own. This student saw value in hearing other viewpoints and viewed it as a growth opportunity for him to better understand the world in which he lived.

> The second major issue is that these social studies introduce a new viewpoint to consider. I recognize that not everyone in this world had as much of an interest in how people acted as I did, but it is still important that people learn how to communicate with others respectfully, especially if they have different opinions on the same ideas. Some of the most interesting comments to me from class had come from people whose views were contrary to mine. It is exactly that type of thinking that I believe everyone should have to experience before entering the real world… But if someone enters the real world without this experience of talking to others with different viewpoints and the argument gets heated, things may not be so fortunate for one person or the other in the end. I know that I valued the chance to hear others viewpoints on social issues in class, and it has helped me grow as a person to understand myself and the world in which I live.

The importance of students taking classes outside of their STEM major cannot be stated enough. Students expressed their pleasure of taking courses outside of their STEM major as a break from their course routine and schedule, but also for the educational opportunities taking non-STEM classes provides them. These courses, according to some students, provided chances

to improve their understanding of the world outside of numbers and equations. As a freshman, female bio-medical engineering major stated,

> There is a tendency amongst STEM students to see the world in the way they have experienced it; in this case I suppose a large amount of physics and chemistry equations. What the human experience is isn't the summation of an individual's experience; students who never get the chance to even slightly peer into this potential are going to be lacking greatly in their understanding of the world around them.

Students recognized the importance of their STEM-related fields and courses. So much so, that many of them engaged in activities related to their STEM major that occupied much of their time. As a result, engaging in non-STEM related activities was difficult from even a time perspective. They simply had none. An STS 201 course offered students an opportunity to branch out of their field and introduced students to subjects and topics they may not stumble upon due to their major. As a freshman, female biology major stated,

> All of my eight courses this semester were STEM related classes. Each week, I attended a molecular biology course, an organic chemistry course, and a physics course, all with their respective labs. Additionally, I worked as a tutor for the physics department. As a pre-dental biology major, my curriculum is based heavily in factual learning and a scientific approach towards modern-day problems in the health-related fields. While I am incredibly passionate about my area of study, I realize there is a drawback to the way in which STEM curriculums are structured. STEM students and professors often dismiss the importance of humanities courses, resulting in a dangerously low exposure to the social issues of our world today.

Some of the students in the course saw the distinction and importance for STEM students to learn and become educated in topics outside of STEM as a means to develop their thinking on issues that were not as well known or familiar to them. Just because one majors in STEM did not mean they should ignore fields outside of STEM. As a sophomore, male physics major added,

> This distinction between the natural and the social sciences is the very reason why I believe STEM undergraduate students should have courses on social science issues. As engineers, mathematicians and scientists we often get caught up in the notion that there is only one correct answer to a problem, as that is how our disciplines usually work. This is a dangerous practice that may promote discrimination and hurt the values of respect and tolerance that our modern society is trying to build upon. We need classes that ensure that our student are developing mature and reasonable thoughts on the issues that affect us as citizens every day, such as socioeconomic inequality, racism or gender.

This student highlighted the importance of an STS 201 course in the overall development and growth of the student and the person. The course helped this student with improvement in social interaction, engagement, and understanding of relevant topics. This carried over into interactions that the student may have at work or engaging in varying group dynamics. As a female biology major stated,

> The first step to address these issues is to first of all know and be educated about it, therefore I believe that STEM students or students in any field for that matter should learn about current and relevant social issues. It's not required for our major but it's required for the sake of humanity….We can improve our interactions with friends, teachers, and even strangers whom we come across. It might not seem too important now, but later on when we get into the work force, we will be exposed to higher levels of

socioeconomic differences, races, and genders. It is highly likely that we would be asked to collaborate or work in the same team as people with these differences. Therefore, to get the most out of working with different people we must build the right ideology now. Whatever we plant now, will flourish later.

The majority of students in this study believed the importance of a STS 201 course as a part of their development as students and as citizens. They recognized how a STS 201 course helped with understanding of people, groups, and social issues. Many also realized that once they leave the college community, they enter a diverse world of genders, sexual orientations, race, ethnicities, and lifestyles. Graduation from college also means a departure of social groups of like-mindedness and an entrance and introduction to diverse groups and communities. Some students recognized this and saw it as a valuable tool in their professional and personal growth. But not all students shared this sentiment. While others saw the course and the intervention module as irrelevant for their degree, career pursuits, and reasons why they entered college.

Irrelevance towards STEM education

The study found some students pushing back on the importance of social justice issues incorporated into a STEM education. A few believed the course to be irrelevant and unnecessary. These same students did not see the link between disciplines outside of the STEM field, nor did they see a reason for students to take a STS 201 course at a STEM institution where their degree pursuit is primarily in STEM. The main theme among students who did not support STEM students learning about social justice issues via a STS 201 course was that it conflicted with the fields they pursue. Some prospective engineers in the course did not see a connection between their work and how it impacted the community. In addition, they did not see that the communities in which they may work was comprised of nuanced individuals from diverse

groups, races, ethnicities, orientations, and lifestyles. A 22-year-old, male engineering student stated,

> I do not support the notion that STEM students should have to take a course to learn about current and relevant social issues in their undergraduate experience because I believe it will not help them in the fields they pursue. Between going through two years of computer engineering courses and having an internship last summer as a software engineer, I cannot remember any moment where what I learned about social issues would have helped me. Overall, it does not have any relation to the technical work we do, nor will it impact the choices I make in my academic major nor the future work I do.

A few students in the study were so intently focused on their STEM major that subject areas that fell out of that realm were seen as time consuming, unnecessary, and mundane. If students were not introduced to these topics early on in their educational career, if they have no exposure to diverse groups, and were in college to strictly earn a degree, to make money, and to jumpstart a career, then learning about issues outside of their focus was irrelevant. The stereotypical thinking appeared to fall under the idea that learning about these issues would not help them professionally or make them any more money. So why should they take this class?

A 19-year-old female engineering students echoed the statement made by the male engineering student. In addition, they questioned the relevancy of the STS 201 course students were forced to take to earn graduation credits. Further, students also expressed the sentiment that I’ve observed in teaching the course for many years which was that the topics discussed in a STS 201 course that touch upon the social sciences and social justice issues were not an emphasis for their academic career and subsequently not a priority.

> Despite this enlightening experience, I am sad to say that I do not think this class should be a required course for STEM majors. Although it taught us about relevant social issues and those on the rise, in completing their degree of whatever science field they are in, social science is not a necessary pool of knowledge to have. Perhaps it can be offered as an elective that doesn't specify STS, but I do not think it should be a requirement.

The theme of the students who opposed STEM students being required to take a STS 201 course rested on the argument that it was not emphasized in their curriculum, that a STS 201 course would not help them with harder math and science courses, and the STS 201 course was not something students have an interest. One of the findings of the students opposed to the STS 201 course rested in the idea that they did not have an interest in the content and subject matter covered in the course. Even after conversation, discussions, numerous articles, and short documentary clips, some students did not value the importance of learning about current social issues.

Students' belief in "change, but no change"

Another interesting finding from the study was students in general claim the course did not change their beliefs or views towards particular issues. This was significant as it highlights a contradiction, a lack of understanding between a "change" versus "having a better understanding of the topic and the material. Majority of students in the study argued the class did not change their way of thinking, however, the course did open their awareness and level of understanding to certain issues more so than they were when they entered the class. This finding potentially conflicted my previous statement in which I stated students argued the course did indeed change their perceptions, while stating the course did increase their awareness, understanding, and knowledge of the issues. Some students consistently stated that the course did not change their

way of thinking or their beliefs, however, argued the course did provide a new understanding and a different way of looking at the material. This lead to the argument on whether or not their way of thinking or beliefs did change, when they were now looking at the same topic but via a different lens, perspective, or understanding. Was it possible for students to maintain the same level of thinking towards certain issues, even though they are armed with new knowledge, a different way of understanding, and a different perspective? This answer rested only with the student, thus for now the study will label it as a "change, but no change."

> This class has not changed any of my views regarding socioeconomic inequality, race, or marriage equality. Before taking this class, I had more of a general perspective about these issues. That is, everybody deserves equal rights, no matter their superficial differences or cultural backgrounds. However, this class has significantly impacted how I see these issues in regards to my area of study. The lesson that I've learned is that these issues cannot take the backseat while I focus on pursuing my degree in biology. Even though my curriculum only requires that I take two classes in the social sciences, I intend to keep up with social issues in any way possible.

A reoccurring theme among the students in the study was that majority of them stated the class did not change their way of thinking, however, they were open to becoming more aware of understanding different perspectives and opinions, and had a greater understanding towards the subject matter as a result of the course. I was uncertain how to differentiate between the two, but it seemed as though the course did not change how students thought about particular topics/issues, but potentially how they felt about specific issues. Below are four specific examples that supported this finding.

A 20 year old female biology student stated:

> In terms of my beliefs and perceptions, I don't think they changed. If anything, I was able to clarify my own beliefs for myself, and better shape my own arguments by finding more examples for how I perceive the situation. When thinking about these issues of inequality, I now have stronger beliefs that I hope will lead me to help make a change in the world, so that the inequality becomes more balanced. It is very idealistic to say that I want to get rid of inequality, so I will say that I want to make a difference in one person's life, and if I can make their life better in any way, that in itself is an accomplishment.

This student argued that her beliefs and perceptions did not change, however the module allowed her to clarify her own positions and afforded her the opportunity to present a stronger argument. However, learning about various issues leds the student to a viewpoint where she wanted to make a difference in a person's life. Similarly, a 21-year-old female engineering student stated:

> Overall in this course, I think I these topics didn't necessarily change my life, but it gave me a reason to think about these topics and really listen and find out all aspects to a topic, as all these large category have multiple angles to be looked at from. Most importantly, I have learned to not just listen to one side of the story and believe that to be true and to not judge other peoples' beliefs. I kind of lived in a bubble, unaware of problems that were happening around the world and even in the U.S. I liked how in this class I was able to deeply think about topics and really develop an opinion without any bias, since all sides were presented.

An interesting note was that though students in the study claimed the class did not change their beliefs and way of thinking, the courses did provide them with knowledge that they previously did not have or were unaware of. Thus, it increased their awareness towards an issue,

but not necessarily changed the way they viewed the issue. As a 22-year-old male, engineering student stated,

> Throughout the semester, the discussions, conversations, and other assignments done in class regarding various social issues have had an impact on me. Although my beliefs have not significantly been changed on issues that I knew about, I became a lot more knowledgeable about issues that either I didn't even know existed or ones that I didn't care much for.

One student made the claim that the course did not change beliefs, but did impact his perception to the various issues discussion. Which leads to a larger question if students who claimed the module did not change their beliefs, but led to an increase in knowledge and influence on perceptions, is there a change? As the 19-year-old male engineering student added,

> Again, this class did not really change my beliefs of the issues we discussed in class, however it did affect my perception of them. The discussions we had and the sources we looked at allowed me to see problems through the eyes of people that are different than me and have different thought processes. I could see why other people thought differently than me about certain topics that we went over. While my opinions did not change, it did make me more perceptive and open to other people's ideas because I could see the experiences some had that made them think a certain way. This may not have applied to all the issues we discussed, mainly the topic of race, but for most of them it did.

Survey data findings: before and after

The surveys provided data to quantify student views on the topics prior to and following the intervention module. However, due to NJIT IRB restrictions, the survey was unable to gauge perspectives prior to the start of the class at the beginning of the semester. The survey data asked

students before and after questions during the time allotted for the survey. However, the survey was not administered before the module began, but rather after the module was complete. Thus, the data below supported the finding that there was change in student views and understanding of the major topics covered.

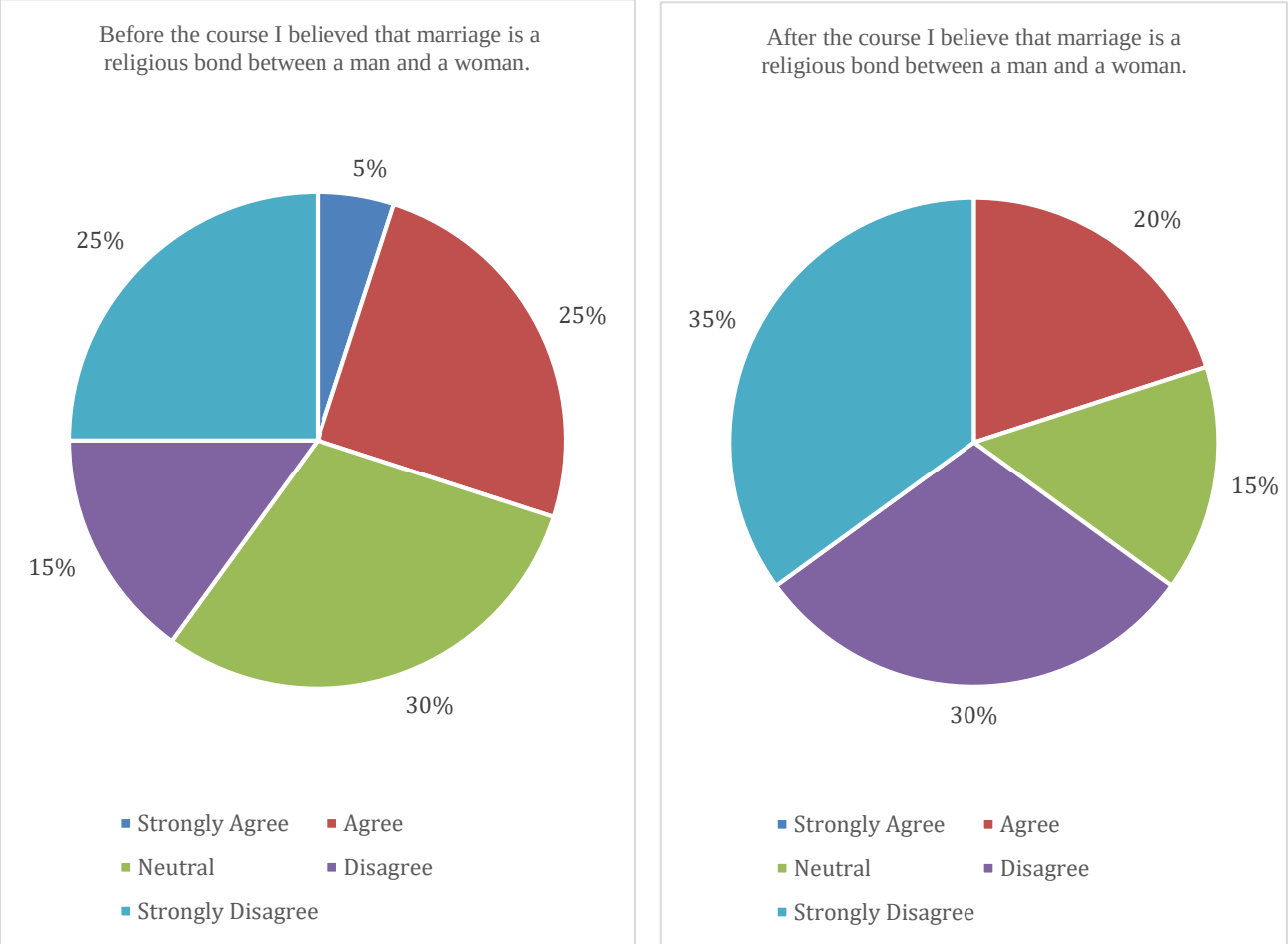


Figure 7. Student beliefs on marriage before and after the intervention

Figure 7 showed student views and beliefs towards marriage being between a man and a woman before and after the course. The figures above highlight mixed responses from students regarding their understanding and beliefs towards this specific issue. Though this topic was generally not a focus of STEM education and NJIT students traditionally did not enroll in the university to study social issues, the intervention module hoped to ascertain student views on

specific issues because these issues were reflective of aspects of the social and cultural world a STEM student entered upon graduation. Thus figure 7 highlighted student views and beliefs on the issue of marriage prior to engaging with the intervention module and following the intervention module.

The data suggested before the course 30% of students agreed that marriage was a bond between a man and a woman; while 40% disagreed, and 30% remained neutral. Following the intervention, 65% of students either disagreed or strongly disagreed, only 20% agreed that marriage was a religious bond between a man and a woman and 15% of students remained neutral. This finding suggested that student perspectives and views were changed in favor of the idea that marriage was not a religious bond between a man and a woman as a result of the intervention module.

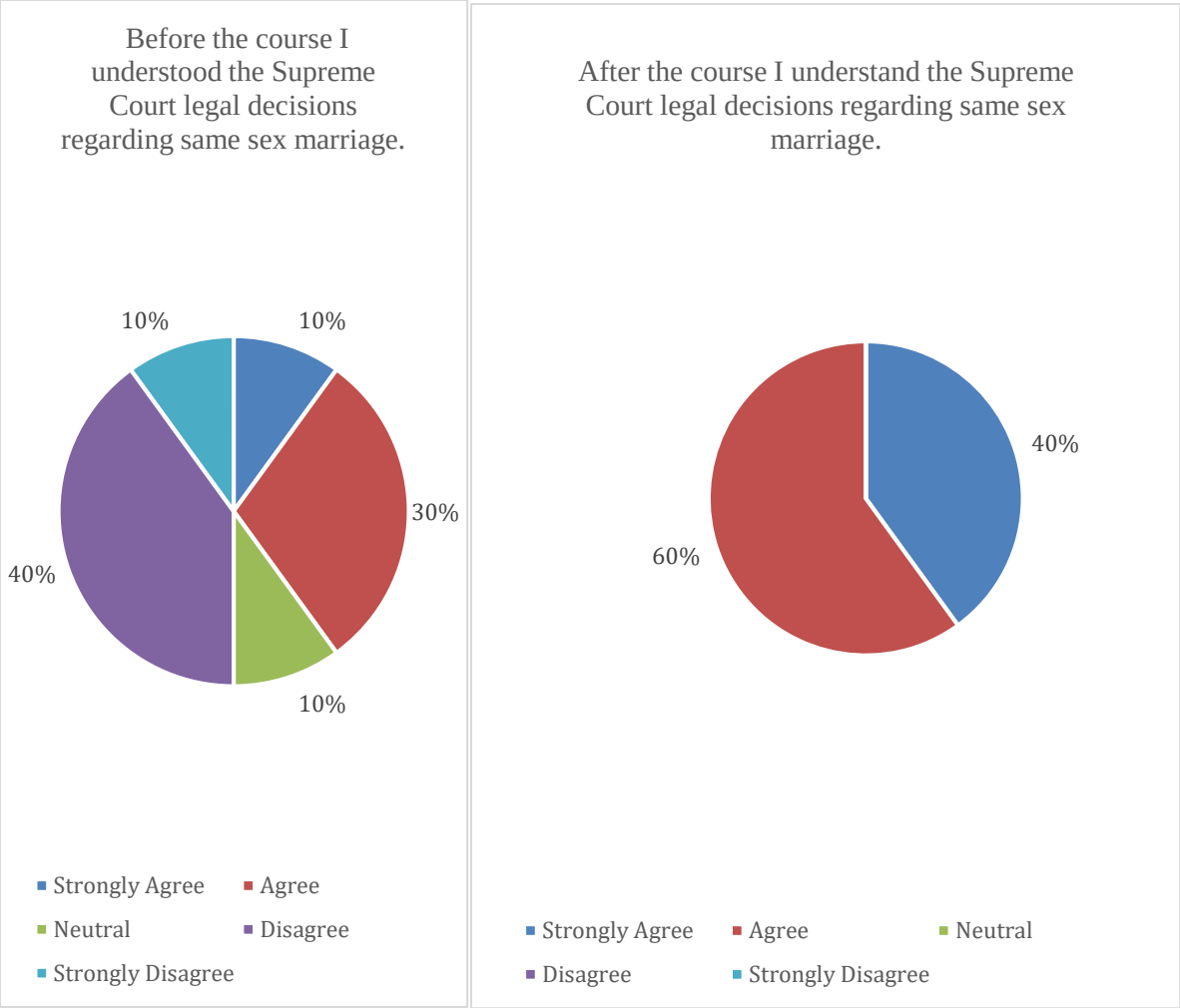


Figure 8. Student understanding before and after Supreme Court decision on marriage

Figure 8 highlighted student understanding and awareness towards the Supreme Court decisions regarding marriage equality prior to the intervention and following. The figures above showed that students in the course had mixed views towards marriage being between a man and a woman. The figure also highlighted student's understanding of the Supreme Court legal decisions that paved the way towards a marriage equality bill before and after the intervention module.

Again, it should be noted that students took the survey at the same time, therefore their responses regarding "before and after" questions were taken following the module. Prior to the intervention module, 40% of students understood the Supreme Court ruling on marriage equality,

50% did not understand the Supreme Court rulings, and 10% remained neutral. However, as shown in the figure above, all students who participated in the survey following the intervention module either strongly agreed or agreed that they now understood the Supreme Court legal decisions regarding same sex marriage following the intervention. This was in contrast to their views prior to the intervention, where it was a mix of strongly agree, agree, neutral, disagree and strongly disagree. This was not questioning their beliefs on same-sex marriage, but rather their understanding towards the legal arguments and Supreme Court decisions behind marriage equality.

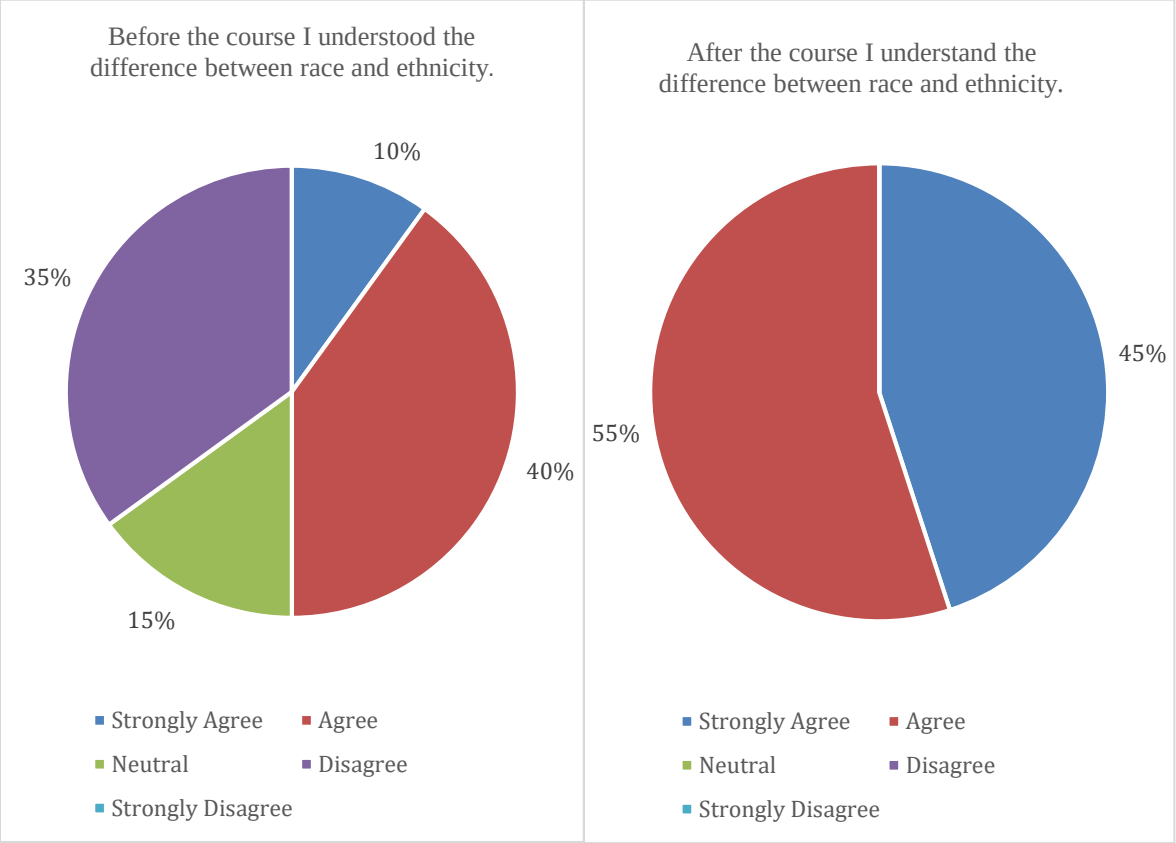


Figure 9. Student understanding of race and ethnicity before and after course

Figure 9 demonstrated student understanding on the terms race and ethnicity and showed a diversity of responses with students almost split regarding their understanding of the difference between race and ethnicity. This figures demonstrated that many students lacked a basic

understanding of the terms race and ethnicity prior to entering the course. In order to have a conversation on race and discrimination, it was important to understand the specific terms and nuances prevalent in the conversation. Sixty percent of students beginning the intervention admitted to lacking this understanding or are neutral.

Again, factoring the variable that students took the survey and responded to “before” and “after” questions at the same time following the module, the figure highlighted student understanding of key terms discussed this semester. Prior to the intervention 50% of the students surveyed either disagreed or remained neutral on whether or not they understood the difference between race and ethnicity. Following the intervention, according to the survey, all students who took the survey stated that they either agree or strongly agree that they know now the difference between the terms race and ethnicity. Again, this question did not ascertain their beliefs on the issues, but gauged their understanding of the terms.

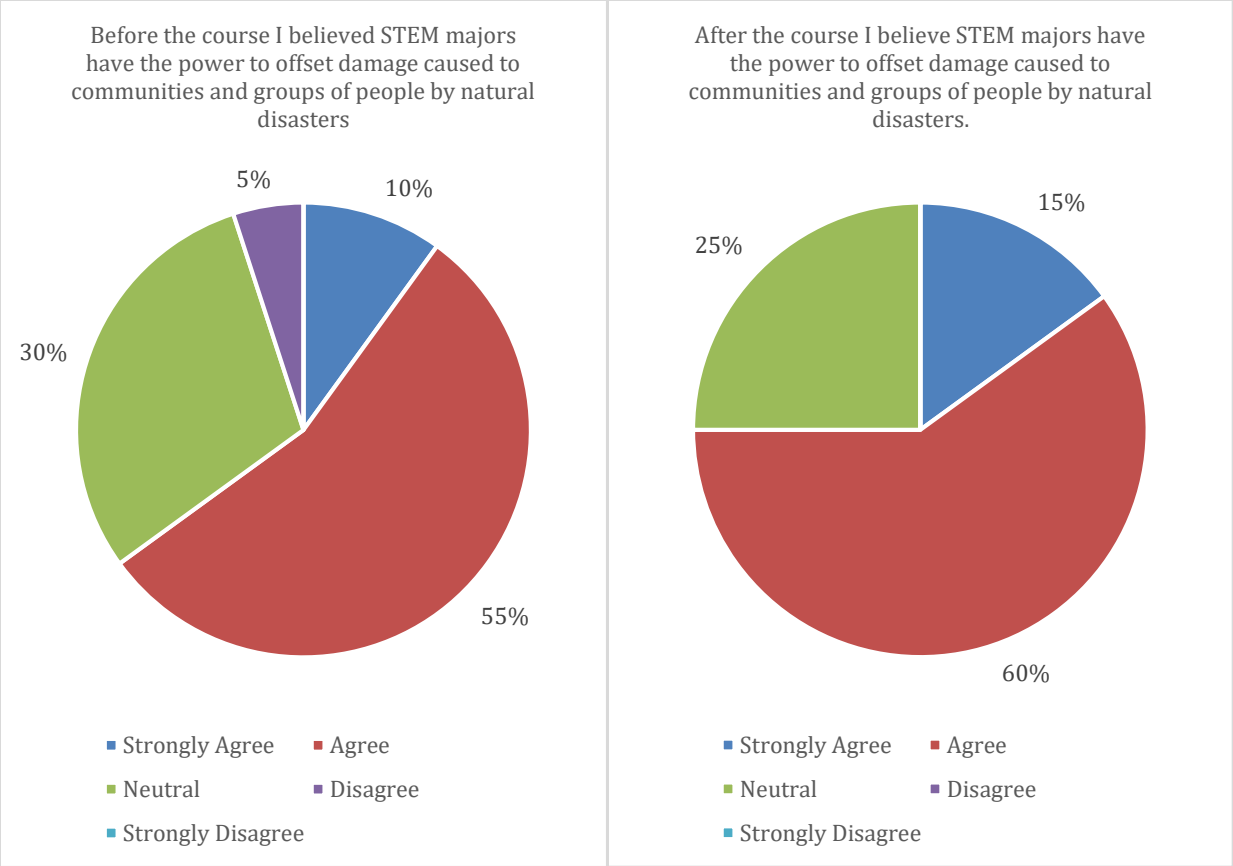


Figure 10. Student before and after views on STEM majors

Figure 10 demonstrated student views regarding the power STEM majors have to offset any damage natural disasters bring on to communities and people. Based on the "before" and "after" responses, the data seemed to indicate that more people either strongly agree or agree (65%) and 30% remained neutral in the belief that STEM majors had the power to offset damages to communities caused by natural disasters, athey did prior to the intervention. Following the intervention, less students remained neutral (25%), 60% agreed with the statement, and 15% of students strongly agreed with the statement.

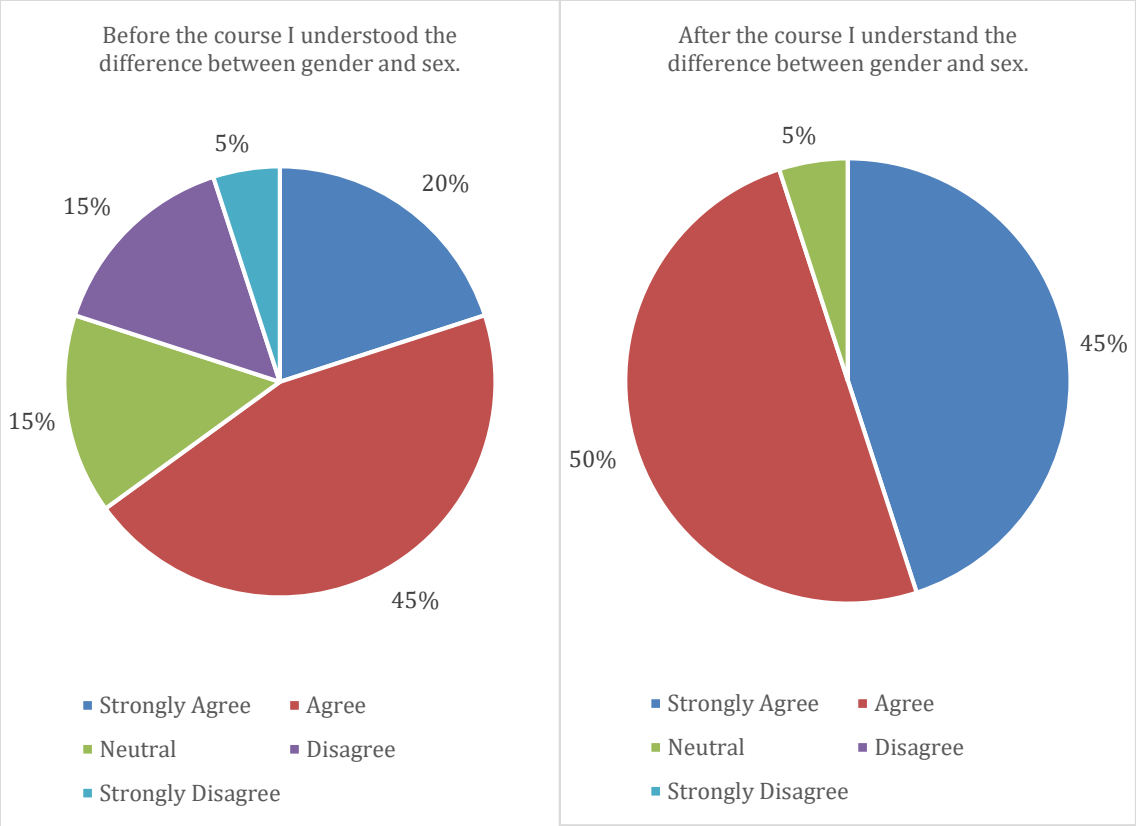


Figure 11. Student before and after understanding on the difference between gender and sex

Figure 11 illustrated student understanding regarding the terms gender and sex prior to and following the intervention. Figure 5 (similar to the results in Figure 3) showed a great deal of variability in the responses of students, with 50% agreeing and the other 50% split in their understanding of the terms sex and gender. This figure demonstrated that many students believed they lacked a basic understanding of the terms sex and gender, prior to the intervention module. Again, in order to have a conversation on sex and gender, it was important to understand the specific terms and nuances that were prevalent in the conversation. Similar to the figures on race and ethnicity, 55% of students beginning the intervention in the STS 201 course lacked this understanding.

Again, this was not reflective of student views towards the topic, but rather an understanding of the difference between the two terms. Prior to the intervention, 15% of students

remained neutral, 5% strongly disagreed, and 15% disagreed to the statement that they understood the difference between the two terms. Following the intervention, 50% of students agreed, 45% strongly agreed, and 5% remained neutral.

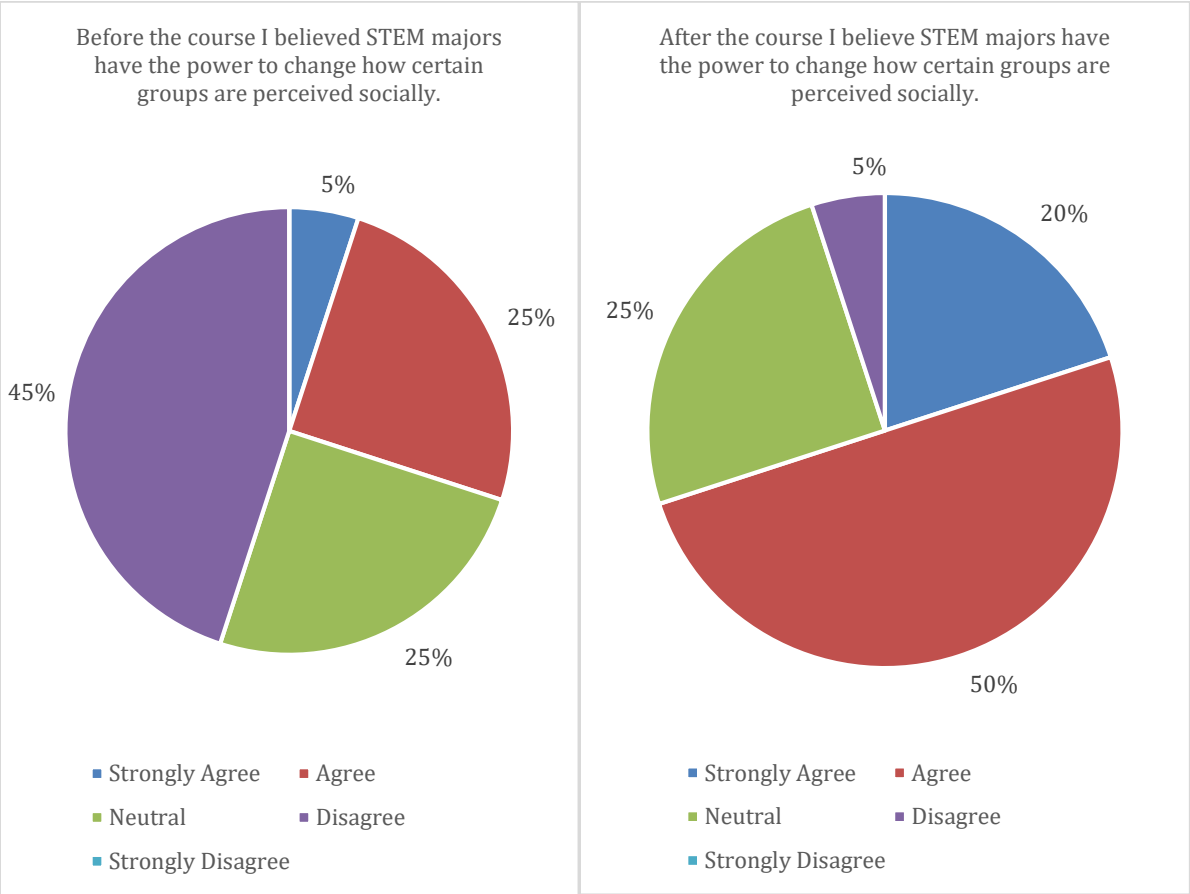
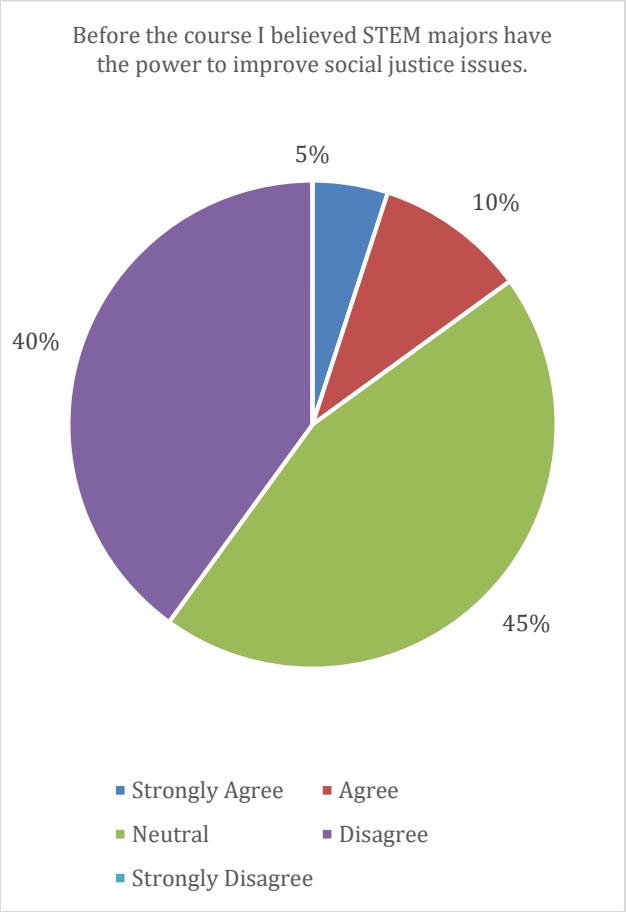


Figure 12. Student views on STEM majors power to change social perception.

Figure 12 illustrated students in the course and their views on whether or not STEM majors had the power to change how groups were socially perceived. Figure 6 highlighted student views on STEM's role in natural disasters and the power to change perceptions of marginalized groups. A majority of students who took the survey believed that STEM students had the power to offset damage caused by natural disasters. Based on these specific survey statements, the responses were mixed and offer a variety of viewpoints from students prior to the intervention module. Figure 6 measured student views on the ability of STEM majors to change

how certain groups were perceived socially. When students examined their views retrospectively, almost half of the students disagreed with this statement and a large portion remained neutral. This figure highlighted that some students in the STS 201 course did not see a connection between STEM and STEM's ability to change how social groups were perceived.

As the data above indicates, more students believed that they have the power to change social perceptions as a STEM majors. This data highlights a shift/change in their thinking prior to the intervention module. Before the intervention module, the data was mixed with 25% agreeing, 25% remaining neutral, 45% disagreeing, and 5% strongly disagreeing that STEM students had the power to change how social groups were perceived. Following the intervention module, 50% agreed, 20% strongly agreed, 25% remained neutral, and 5% disagreed with the statement.



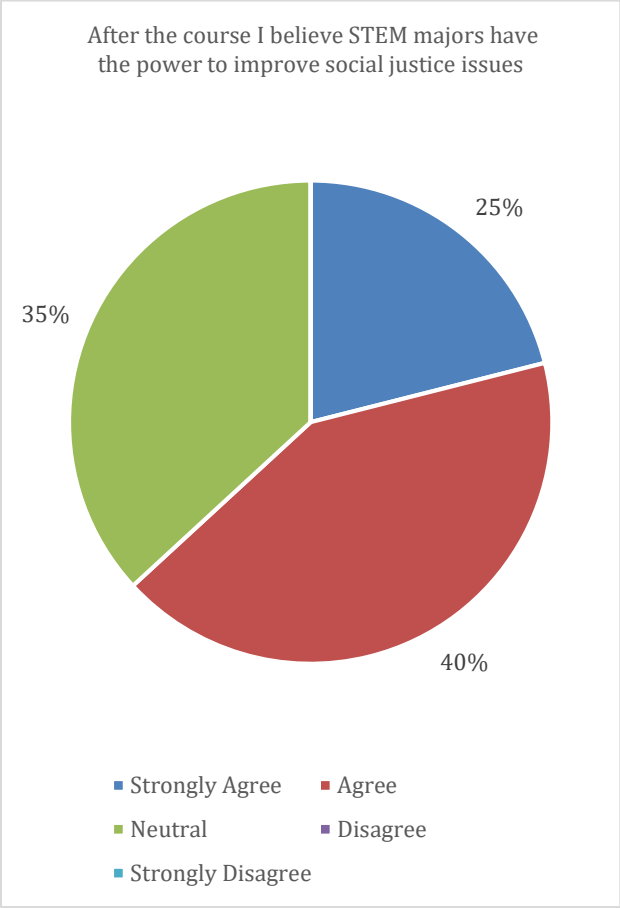


Figure 13. Student beliefs before/after course regarding STEM majors and social justice

Figure 13 illustrated a significant finding as a result of the intervention module. A majority of the students who took the survey agreed that, following the intervention module, as a STEM major they had the power to improve social justice issues. The data indicated that prior to the intervention, 85% of students surveyed either disagreed or remained neutral on this questions. However, the post-intervention data argues that opposite, that 65% either strongly agree/agree while 35% remained neutral.

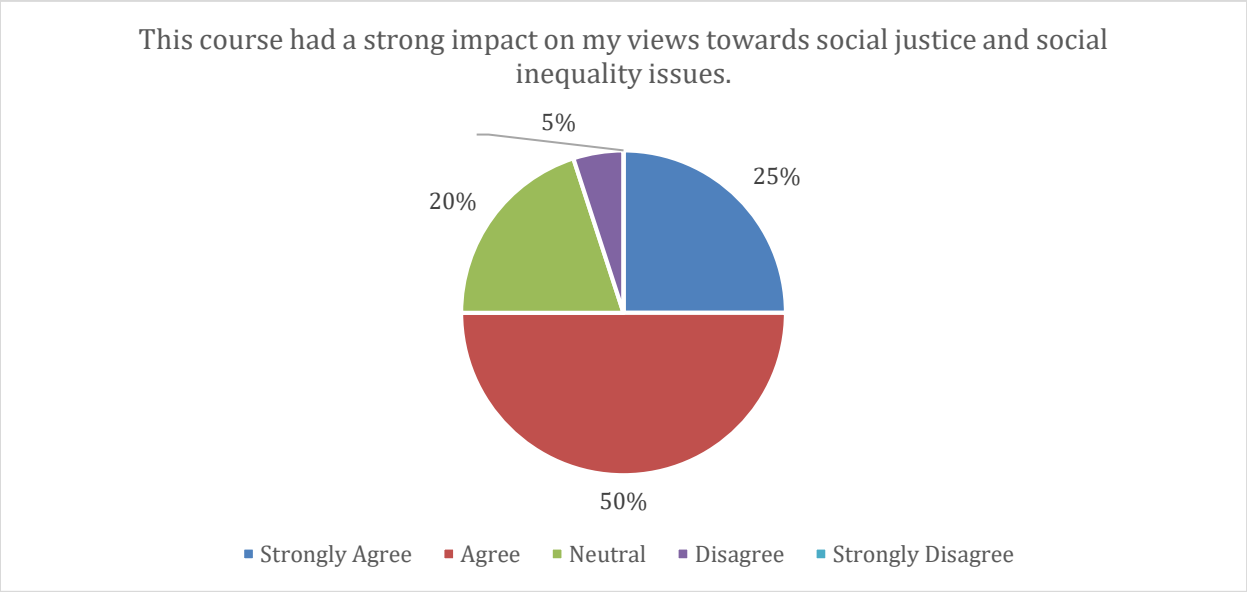


Figure 14. Student views on the impact course had on views on social justice

Lastly 75% of the students surveyed stated that the course had a strong impact on their views towards social justice and social inequality. Twenty percent remained neutral and 5% disagreed.

Based on the survey data and student responses, students entered the STS 201 course with varying perspectives and understanding of common social issues. The surveys above demonstrated the wide ranging perspectives students had towards issues such as socioeconomic inequality, race, gender, and marriage. As stated above, these “before” questions were not provided at the start of the semester (due to IRB issues). These questions were taken at the same

time as the “after” questions, in one sitting, thus the students were asked to recall what they felt and thought four months ago.

Findings Conclusion

The intervention module discovered multiple things about the STS 201 course and the students who enrolled in the course. The course provided students with exposure and attempts to draw awareness to current social issues. Using various sources that range from articles to documentaries, the course offered students information relevant to the issues in the course. What I discovered is that many students entered the STS 201 course with a general and/or superficial knowledge of the topics we discussed. They carried a conversation, but the details and substance of the conversation was rooted in opinion, bias, and a belief that was rooted in their cultural and social upbringing. For example, students frequently engaged in conversations about race, ethnicity, gender, and sexual orientation and the surveys suggested that prior to the intervention module, many of them believed they understood the nuances that were attached with these terms. But it was not until the end of the intervention module, when students were asked to compare their perspectives and understandings of these terms before they entered the course and after, was it clear that the course helped them learn what these terms actually mean. And having the knowledge of the basic facts helped them strengthen their beliefs, understand their positions better, and/or broaden their perspectives.

The course provided a framework for students to engage and interact with the content and with those whose views and beliefs of the specific content were different from their own. As a result, the intervention module asked students to have individual face-to-face conversations and discussions with a large group of their peers in class. The data responses found that students believe these conversations to be beneficial and helpful in better understanding the social issues,

but also to increase their understanding and awareness of those whose views were different than their own.

This was the most important finding of the study and will be discussed in depth in Chapter 5. Students in general wanted to talk to each other. They wanted to know what the other was thinking, they wanted to know more about their peers, and they sought to have conversations, both in small and large groups, so they could learn more about the issue, about others and about themselves. That data responses indicated that every student in the STS 201 course found the conversations helpful, interesting, or at the very least, informative. Some students took the opportunity of these conversations and discussions to ask questions and to learn more about someone they are close to. Other students found the conversations and discussions as a tool to fortify their beliefs and ideologies, while acknowledging the importance of remaining open to listening to other perspectives. Most students in the study believed that STEM students should learn about social issues and find it both relevant and important to their career and their individual impact on the world. While a small minority argued they did not enroll at NJIT to study these issues and classes like this should not be a part of a STEM curriculum.

All in all, the intervention module successfully helped students to distinguish between terms used in everyday discourse such as race, ethnicity, sex, and gender. It provided students facts on Supreme Court rulings on marriage equality, which provided students an understanding toward the specific legal aspects from the cases and broaden their understanding of our social and cultural world. The intervention module also provided the structure for students to carry conversations with one another, to learn from each other, and gave them the opportunity to engage and interact using civil discourse as the main learning tool. The data responses demonstrated that students embraced the opportunity to have these conversations, to learn from

one another, and were open to hear other points of view. The module and course may not have changed their way of thinking, but for some, it broadened and enhanced their social and cultural perspective.

Chapter 5: Discussion

As an STS 201 lecturer for seven years, I observed and taught students taking an STS 201 course. As a result, these observations and pedagogy were the inspiration behind the creation of an intervention module. For years, the STS 201 course focused strictly on social science theory and the relationship to technology and a student's professional career focus. The course was void of discussions regarding social inequality, race, sexual orientation, and social justice. As I taught the course, I noticed an uptick in negative rhetoric and perceptions towards various social groups in class conversations and discussions. Presumably, these perceptions came from numerous media outlets, "shares" and conversations via Facebook, tweets and retweets via Twitter, all which seemed to fuel preconceived notions that students held towards individuals and groups different from them. As a university lecturer that interacts and engages with freshman, I brought issues that address social inequality, race, and sexual orientation to the forefront of an STS 201 course and attempted to connect the issues to a NJIT student's STEM educational experience. Through the years, subjective assessment was that a large percentage of students enter NJIT with low social awareness towards social justice issues and socioeconomic issues. In addition, I observed that many viewpoints are shaped by various forms of media they use (specific media outlets, new programs, websites, and online groups) or not shaped at all.

Summary of the study

This study took place at the New Jersey Institute of Technology (NJIT) in the University Heights district of downtown Newark, NJ. Using an Honors STS (Science, Technology, and Society) course, I examined if an STS 201 course can be redesigned to introduce students to social issues and social inequity issues, if it taught students how to think critically and deeply about the impact of their work has on these issues, and if students left the redesigned STS course

with a deeper understanding of themselves, and gained a broader perspective of social issues and social inequity. Further, I was interested to see if the course provided students opportunities to draw connections between their field of study and the issues addressed in the course. Since students do not enroll in NJIT to take STS courses, but rather to earn a degree in STEM, I designed this two-month-long intervention module and introduced STEM students taking an STS course to social issues and social inequity and their connections to STEM fields. The intervention module introduced specific examples that related to social issues and social inequity and I assessed student views, engagement, and perspectives on specific social issues.

The findings of the study suggested that students, in general, lacked exposure and background to the nuances of various social issues upon entering a university setting. They were aware of the issues and possessed superficial knowledge, but it was not until they were in a class, where they were exposed to facts and discussed the moral and ethical aspects of the issues, that they began to see how much they really knew.

Further, students appeared to value the discussion and interview portion of the module. Students expressed satisfaction and reacted positively to the exercise of discussing social issues with their peer group and hearing other students' perspectives. This talking and listening exercise helped students understand one another, but also garnered a better understanding of themselves and their own individual perspective.

At the completion of the study, many of the students in the course expressed a desire for STEM students to take more classes such as the STS 201 Honors course during their college experience. They believe these types of courses introduced and engaged students with content and topics they most likely did not find in their STEM courses and major. Of the 28 students who took the STS 201 course, 24 students expressed both an interest and a need for

undergraduates at NJIT to take courses that discuss a variety of social issues. These 24 students also expressed the importance of STEM students' awareness towards social issues and issues of social inequity.

But not all students reacted positively to the topics introduced in the STS 201 course. Of the 28 students who took the STS 201 Honors course, four students expressed negative views and looked unfavorably at the topics in the STS 201 course as unnecessary for the educational purposes of a STEM student at NJIT. In fact, these four students supported a long held belief that STEM students lack social and cultural awareness and are only focused on their field of study (Garibay, 2015).

Overall and based on the survey data, most students left the STS 201 course more knowledgeable of the topics in the course and many of them reevaluated or reexamined their own perspectives and viewpoints. Further, this module and study supported the ideas that discussion and conversation are both necessary in the classroom, but also desired by students to have in the classroom. Students, in general, believed the module helped them in different ways, however, it was through the conversations and engagement with their fellow peers where it seemed most of the learning took place.

Discoveries

Exploration of perspectives

My study supported the work done by Banks (1991 & 1993) and Ladson-Billings (1995) who argued that education helps students understand various types of knowledge and engages students in civil discourse while aiding them in the creation of their own interpretations, perspectives, and understanding their own positions, beliefs, ideologies, and assumptions

(Banks, 1991 & 1993); and that the exploration of cultural characteristics, individual experiences, and diverse perspectives into the cultures and realities of all students expanded the curricula and knowledge of a student's educational experience (Ladson-Billings, 1995).

Students participating in the study appeared to appreciate the process and exercise in listening to and voicing their own perspectives towards the social issues discussed. They were motivated, eager, and willing to discuss issues at great length, listen to others, and ask questions. An interesting point that resulted from the study is that students in the course appeared interested in education that is centered on human rights awareness and that focused on critical thinking and the ideals of tolerance of diversity. Further, this approach fostered an educational culture where students evolved into critical thinkers and developed the knowledge, skills, and attitudes required to participate in reflective civic action. The intervention module potentially lit an interest towards social justice issues, even those issues not applicable to certain students. As one student stated,

> Besides gaining knowledge and seeing new perspectives on the issues, I also feel as though I became a bit more interested in social issues. I never really cared about too many social issues before this class, since many of them don't really apply to me. As a middle class white male, I have never felt the need to worry about racism, socioeconomic inequality, gender issues, or same-sex marriage, as the statuses of these issues wouldn't affect me personally. However, now I have started to pay more attention to social movements and other problems that I see around me…I will definitely pay more attention to them and go out of my way to become more knowledgeable about them.

This study tapped into an aspect of an individual's learning experience that was latent, dormant, or possibly non-existent. It drew attention to issues, but also, allowed students the opportunity to

analyze and evaluate their own perspectives, views, and beliefs towards the issues. It provided them opportunities to see how their perspectives stacked up against their fellow peers. Further, it gave them the opportunity to discuss, evaluate, and analyze views of their peers and of their own.

Social justice education

If the intervention module served as an introduction to social issues for some and sparked an interest in learning more about social justice issues in others, a further analysis supported the idea of the effectiveness in the implementation of programs promoting social justice awareness. Student ideas were met with overall positive results and they found value in learning about difference, they interacted across cultures, they communicated better with others, and they were more sensitive in their attitudes towards the experiences of others (Hirschinger-Blank, Simons, Finley, Clearly, & Thoerig, pg. 14, 2013). A sophomore, female computer science major stated,

> If a computer programmer thinks that he or she does not need to learn about transgender and homosexuality, for example, because he or she will be spending all of his or her time in front of a computer, then he or she will likely be caught off guard when he or she recognize the impact that these social issues have on his or her job.

The honors class appeared eager, curious, and engaged with the subject matter centered on social issues. As we focused on issues of equality, race, and gender, the questions and interactions were mature, enlightening, and educational for me as the course instructor, as well as the other students. An honors curriculum was an ideal venue for introducing complex conversations that transformed classroom discussions into active social change (Klos, Eskine, & Pashkevich, 2014), as students began to question the complexities of the issues, as well as, their own understanding of the issues. Social justice infused with multi-academic and multi-disciplines with faculty-created opportunities for students to collaborate with the broader community, exposed students

to social justice issues, encouraged self-reflection, and students became change agents with increased student self-awareness and understanding of social justice (Miranda, Radlife, Cooper, & Eschenbrenner, 2014). A 20-year-old female dental student continued,

> Thus, the social sciences are extremely beneficial and should be mandatory for everyone, especially STEM students. Some argue that an engineer doesn't need to learn about current events and social issues, but what's the point of having an engineer who knows nothing about the world he or she is living in. Not only that, but I think the open discussion about topics like racism and gender inequality fosters open-minded people. I truly believe that the people who can make great impacts in the world are those with open minds and hearts free of hatred.

Students appeared to not have the opportunity to experience engagement and interaction with social justice issues outside of the STS 201 course prior to start of the semester. During the intervention, students appeared engaged in the learning about social justice issues and discussed their views on specific issues. Some of the students claimed they had little to no knowledge on certain issues and thus the exposure, discussion, and engagement with the material offers them an insight into perspectives they had little experience with.

Common views of STEM students

One of the biggest issues raised in the literature examined STEM students' views towards social issues and social inequality. Garibay (2015) found that STEM students who sought to become engineers, computer scientists, and scientific researchers had low levels of social awareness and saw the importance of working for social change as less important to their career goals. In addition, students who spent time as a STEM major are more likely to show signs of lower social awareness at the end of college, and majoring in a STEM field has a negative

relationship with students and their understanding of diverse global communities. The study found that STEM undergraduates were more likely to believe that the individual cannot change society or influence social issues than students who majored in humanities or the social sciences. A further analysis into the data of the study I conducted found that students, in general, expressed interest in social issues and social inequity, however they lacked exposure and experience to the topics beyond a superficial level. Reactions, for example, by this sophomore, male engineering student who stated,

> All the topics we discussed throughout the course were issues I had heard or read about before. However, I came to realize that my thoughts and positions were mostly superficial and they lacked any sort of strong foundation.

And a sophomore, male biology student shared that,

> Prior to reading in depth about natural disasters and viewing clips, I had always thought of these disasters as sad occurrences, unable to grasp the sheer intensity and pain. I could only view these events as isolated outbursts of Mother Nature. They did not affect me, and I could not empathize much.

There was a certain level of awareness that students possessed on social issues topics. And the initial assumptions of my study supported Garibay (2015) when he addressed STEM students and their level of socio-cultural awareness. This is supported by a student who stated that prior to coming into the class they lacked in-depth knowledge, awareness, and/or understanding of the degree in which social issues impacted various groups. A common characteristic among STEM students at NJIT that took a STS 201 course over the years was that they lacked knowledge of socio-cultural awareness and this study, based on student responses, supported this idea.

Self-reflection

Throughout the study, students had numerous opportunities where they engaged in self-reflection. From the focus group, to the questionnaire and the reflective essays, students had time to consider their individual views on certain issues and why they thought the way they did towards the issue. This study supported the findings of the work done by Schon (1983, 1987) who argued that students engaged in self-reflection utilized a learning tool that benefitted and improved their understanding of interactions and relationships among people, communities and societies, both personally and professionally. Reflection upon their experiences allowed individuals to think about what has occurred, its relationship to our past, present, and future actions, and had the potential to reshape what we are doing while we are doing it (Schon, 1983, 1987). Students in the study used self-reflection and analyzed individual views and theories and placed them against the theories in use. Through the process of self-reflection, students were able to identify assumptions behind thoughts and actions, evaluate the assumptions, and explore the connections to our experiences and provide opportunities to make ideas more inclusive and integrative with multiple aspects of society (Merriam & Bierema, 2014; Brookfield, 1991; Schon, 1983). As a freshman, female engineering student stated

> Prior to viewing the clips and reading the articles about natural disasters, I did not spend much time thinking about natural disasters. Having experienced Hurricane Sandy so close to home forced me to pay attention to it, but even though I knew there was a lot of devastation caused by Sandy, I did not make connections between a disaster like Sandy to the socioeconomic conditions of certain communities. I had not really thought about the effects of Sandy on poorer communities, I just focused on what was happening in my community and what was being talked about on the news.

Reflection and introspection led to individual contemplation and eventually into a conversation with others about ideas and perspectives. The reader response essays showed some of the students' thoughts about their own experiences, views, and perspectives, but also reevaluated and re-xamined how they thought about and engaged with the issues. At what point in a student's academic experience are they taught and/or provided the proper learning tools to reflect on their individual life journey and their experiences? At what point are students provided the opportunity to reflect on their past, to see how it influences their present and how it will impact their future? The process of self-reflection for this study allowed students to consider their view and ideologies and examined their place in our 2018 political, social, and cultural climate.

Dialogue

This study incorporated critical social dialogue as one of its pedagogical practices. Critical social dialogue (CSD) improved intergroup relations, taught students about stereotypes placed on racial and ethnic groups, discussed the common humanity that connects social groups, and taught skills to interact effectively with students from other groups with learning about others and their specific environments with reduced fear and anxiety (Chavez-Reyes, 2014). Critical social dialogue was difficult to engage in and teachers should be aware of the consequences of a potential engagement of controversial topics. However, introducing critical social dialogue in the undergraduate experiences enabled a framework that emphasized multiculturalism, social justice, and democracy, and was the first step towards introducing students in the course to a mutually beneficial social justice education. Critical social dialogue improved intergroup relations, taught students about stereotyping towards racial and ethnic groups, taught about the commonalities of our humanity that connects all social groups, and

addressed social skills to effectively interact with diverse groups of students and to learn about others environments. As a freshman, female biology student stated,

> Our class conversations have shown me that there are multiple points of view, more than I even imagined. Additionally, I didn't think that there would be a connection between what seemed to be two random different topics. I learned that I need to have a broader outlook on life because, in a way, things that seem to be on the opposite ends of a spectrum can still be connected.

It was through face-to-face encounters group members were likely to reduce prejudice compared to courses that do not encourage interaction (Allport, 1954). It was through dialogue that students were eager to engage in taboo topics, as well as conceptualize the terms, theories, and ideas that appeared in their textbooks. As a student stated, regarding her conversation with another peer on the issues of race and discrimination:

> My conversation with him has helped me to understand some of the reasons behind why discrimination and prejudice still exist today and how discrimination can cause more discrimination and that it is not one sided. It also helped to me to understand that although bias can be overcome by people that it is hard to do, due to our natural instincts.

Throughout the study, conversations improved cultural competency, decreased prejudice, and exposed students to varying perspectives towards social justice issues. Dialogue and engagement offered students the opportunity to learn beyond stereotypes, saw people as individuals, and viewed others through a lens of patience, attentiveness, and caring (Harris, 2003; Stough-Hunter, 2016). A curriculum engaged in dialogue, face-to-face interaction, and introduced students to individual experiences resulted in a student more aware of the social, political, cultural, and economic contexts in which diverse individuals work and live (Chavez-Reyes, 2012;

Jakubowski, 2001; Harris, 2003; Stough-Hunter, 2016; Jordan et al., 2001). In turn, the student became more socially and culturally aware of others, and how personal, political, cultural, and religious beliefs shaped their own and other people's perceptions and values.

Willingness

The discoveries from this study listed above would not be possible were it not for students in the STS 201 course and their willingness and eagerness to engage with the material, the content, and conversations about topics and issues not connected to their academic major. The students in this study were easy to teach, expressed a desire to learn from each other, and eager to share their views with one another. Because, traditionally, the STS 201 course is not related to their major, there is often very little motivation to take a course like this for STEM students at NJIT. However, the class motivated them to become aware, engaged, and involved with the issues and, for some, lit a spark of interest directed at social issues.

The intervention module would not have worked as well as it did were it not for the participation of the students to engage in discussion. The class took place at 8:30 a.m. yet even the most tired students were excited and eager to participate in dialogue in which their voices were heard, their feelings shared and their understanding of social issues expressed, debated, and at times, challenged. Based on the study, students were excited to converse with each other, learned of topics they lacked a full understanding of, and used the opportunity to engage in mature, authentic, and important social and cultural conversations.

Study Limitations/Potential Bias

This study examined the experiences of NJIT students in a STS 201 Honors course. As the researcher a limitation in this study was that it only focused on students enrolled in a STS 201 Honors course and ignored the majority of the NJIT population. In addition, the Honors

course had 28 students, compared to a general STS 201 course which has upwards to 75 students. Further, the course itself does reflect the male-to-female ratio at NJIT. NJIT as a 4:1 male to female ratio. This particular Honors course had 13 females and 15 males. Thus the study did not reflect NJIT students as a whole, the NJIT population as a whole, or the specific demographic breakdowns, but rather NJIT students who enrolled in the STS 201 Honors course. In addition, since I taught the STS Honors course, a potential bias was evident in that, as the researcher, I hoped to see positive results of this study. Every attempt was made on my end as the researcher and course instructor to conduct this study unbiasedly and objectively.

Another limitation of the study was I did not conduct a pre- and post-survey assessing student views and beliefs on specific topics. Because the study involved a course I taught, to avoid any potential conflicts of interest and to be respectful of students unwilling to participate in the study, I elected not to have pre-tests. Further, NJIT IRB limited the range in which to conduct a pre-survey. As a result, I was only allowed to conduct one survey, at the end of the semester, with both pre-module and post-module questions. This forced the students to reflect on their thoughts and views from the beginning of the semester at the end of the semester. This might play a factor in student responses.

Data collection from current students

This study asked current students in a STS 201 class that I taught to voluntarily and anonymously participate in a survey and a focus group. In addition, the reflection essays of the students were collected on a volunteer basis and any information used from these essays in the study was anonymous and confidential. Collection of the reflection essays commenced after final grades were submitted. Student names were not used. Lastly, the focus group was anonymous and confidential and names were not given or discussed.

Potential Bias

Because I designed the intervention module, I entered the study with a specific idea of how I wanted the class to run. In the future, I should consider rather than initially introducing topics such as race, ethnicity, marriage equality, and gender, I may introduce a specific case study or example and through the module allow the students the opportunity to draw conclusions for themselves. This may serves as a pedagogical strategy for students who may seem put off by the topics and/or not interested in learning about social issues. In addition, by presenting students with a specific scenario and allowing them the freedom to explore it as a STEM student, the potential for more learning opportunities, experiences, and perspectives may arise.

Implications

Based on the findings of this study, students in the STS 201 course found it to be an opportunity to explore their perspectives and the perspectives of others; allowed them to engage in self-reflection and consider aspects of social issues they never thought of before; discuss social justice issues and address concerns of issues affecting society in 2018; and showed a willingness and excitement to exchange in dialogue and have discussion regarding various perspectives and interpretations of different social issues. The findings show that students entering NJIT possess knowledge and interest in social issues, but may not have the opportunities to discuss them in an educational setting. Allowing students the opportunity to respectfully discuss, engage in debate, and challenge one another on their views towards social issues is an aspect of university life that should be nurtured, fostered, and grown. This type of engagement will create positive results in the classroom environment and allow for student growth and development.

The findings from this study can be used to make recommendations to improve both university and classroom culture, to support incoming students at the university, enhance classroom pedagogy, and offer suggestions for future research in education.

University policy

The university should make attempts to gauge student perceptions and beliefs towards current cultural topics and social issues upon entering as a freshman. Today, university campuses seek to create learning environments where students engage in meaningful practices, work, and collaboration with others to be socially responsible local, regional, national, and global citizens and universities are slowly focusing on students exploring personal, social, and ethical responsibilities to others (AACU, 2010). This action can be supported by providing a freshman-wide survey on the first day of the first semester of their freshman year. Then students should take a follow up survey in the Spring semester of their senior year. This survey would determine how student views and beliefs towards social issues changed during their education experience at NJIT, if at all.

The university should require more than just 2-3 non-STEM courses as a graduation requirement or should implement pass/fail seminars that address current moral, ethical, and social issues pertinent to the students' lives. It would be in these courses where students are engaged in conversation and discussion with both the professor as a moderator and with frequent guest speakers that address varying perspectives, ideologies, and viewpoints. UNESCO states that students should "acquire knowledge, understanding and critical thinking about global, regional, national and local issues and the interconnectedness and interdependency of different countries and populations" (UNESCO, 2015). A means to reach this end is to provide students various mediums and learning opportunities. Consideration of students to minor in a field outside

of STEM with the expectation that a well-rounded, socially- and culturally-educated STEM graduate increases their marketability in the global workplace competition is one way to heighten student interest towards this potential minor. In addition, it makes the student a social and culturally aware individual who possess the skills required of a STEM student, but also, the necessary knowledge and tools to be a socially conscious citizen. Gurin, Naga, & Lopez (2004), in their study of multicultural programs, argue it is the duty of higher educational institutions to bring students of various racial, ethnic, and cultural dynamics together in meaningful ways, to engage in civil discourse, and to learn from one another. This is important, especially at traditional STEM higher educational institutions.

STEM students, for example, show less signs of social agency and social awareness at the end of college as compared to non-STEM majors (Garibay, 2015). Garibay (2015) surveyed a national sample of over 6100 undergraduates and found that STEM majors are more likely to see their field of work as not something that can contribute to the overall promotion of social justice issues. If requiring more non-STEM courses, more humanities and social science courses, or liberal arts courses increases a STEM student's social agency and social awareness by the time he or she graduates college, then the university has done its part in properly educating the whole student, not just a portion. When universities address the needs of the larger, diverse student population, it increases the chances of building common understanding and relationships through cooperation and collaboration. Through this new relationship, complex global problems are addressed and a sense of shared purpose is created (Neumann, 2014; Sogunro, 2015; Ramaley, 2014).

Classroom pedagogy

Based on the study, most students want to engage in conversation and discussion regarding social issues that affect their generation. One pedagogical practice that assists in this process is self-reflection. Self-reflection is the process that moves learners from one experience to the other through connections and drawing inferences and requires students to value personal, emotional, and intellectual growth of themselves, others, and the relationship shared with the community (Dewey, 1912). It is not enough to provide students factual data and information. This needs to be complemented with pedagogy and teaching where student beliefs, perspectives, and voices are expressed regarding how each individual student views the particular social issue. This exploration allows students to not only understand the issue in a larger context, it provides them the opportunity to understand why they think the way they do. Further, it provides a challenge to them, as they have grapple with understanding their own individual perspective in the context of multiple other understandings and perspectives. Einfield & Collins (2008) study found there is a general consensus among students that individuals and institutions should be civically engaged and contribute to their communities. However, the data also highlights that students have varying ideas of what engaging with the community means and this definition is shaped by a difference in attitudes, upbringing, backgrounds, and perceptions. Through the process of self-reflection and engaging dialogue with other students, they potentially make connections of both the similarities and differences that connect students and society together.

Educators need to consider where students currently have these types of conversations. When diversity is examined and intergroup contact in higher education is addressed, democratization through social justice education in the intergroup dynamics emerge when students in the courses engage in dialogue, discussion, and group activity (Ross, 2014). At the university setting, if it is not in the classroom, then it is in the dining hall, the dorms, or in

specific groups and clubs that students have joined. It is online, through social media, and the numerous discussion websites, such as Reddit, where students are frequently engaged with other peers who share the same social perspective. An important factor to consider is that most of the students control the setting in which they have these conversations. They choose who to sit with in the dining hall, they choose who to have conversations with in the dorms, they choose the social groups and clubs at the university, and they choose which social media groups, platforms, and discussion forums to engage in.

In contrast, the classroom is one of the few places for the student in which there is a controlled environment with an adult educator who can facilitate and moderate intense conversations and discussions with 25-45 students of various backgrounds, perspectives, and lifestyles. Face-to-face classroom discussions are not echo chambers supporting student beliefs and ideologies. In fact, classrooms are a venue where students have the opportunity to voice their ideas, hear from others, challenge other belief systems, and see how their views fare in the face of opposing views. Critical social dialogue improves intergroup relations, teaches students about stereotypes placed on racial and ethnics groups, discusses the common humanity that connects social groups, and teaches skills to interact effectively with students from other groups with learning about others and their specific environments with reduced fear and anxiety (Chavez-Reyes, 2014).

It is the responsibility of the educator to be an impartial, unbiased, and reflective voice in the classroom, so as to provide a culture and classroom environment where all students feel comfortable speaking, and are respected and challenged. Universities, educators, and lecturers that adopt multiple perspectives, experiences, and alternative voices through a student's academic learning experience enables students to develop broader perceptions, identities,

experiences, and further engagement with other disciplines and social understandings. (Lizzio, Wilson, & Hadaway, 2007). It is then where students are introduced to a world of varying perspectives, backgrounds, beliefs, ideologies, and understandings. They learn from each other, they learn about each other, and, as a by-product of this exercise, learn how to work with, interact with and collaborate with those who are both similar and different than them.

Future research

Much of STEM education research right now focuses on STEM education's growth and how to make STEM more diverse. As the focus of this study was to examine STEM students' views and beliefs towards social issues, future research should further explore this field. If higher education can harness the power of STEM education, coupled with education on current social and cultural issues, what results is a well-rounded, socially aware student who potentially engages in socially responsible practices. More research should focus on how STEM education and STEM students can improve the lives of the local, regional, and national communities. Further research should be done in fields where STEM is not viewed as an isolated field, but rather how STEM can improve the living conditions and the quality of life for all people on the planet.

In our technology-oriented society and culture, it is still important to retain some traditional modes of engagement and interaction. As a result of this study, future research should include the effectiveness of discussion-based classes on a student's educational experience. Given that the current and upcoming generations are technologically savvy and versed, there are some nuances in face-to-face engagement that are absent in conversations held via technology and through social media. Specifically, when students engage in face-to-face conversations, they hear the voices of their peers, they pick up on the inflection of their voices, and the tone. They

can physically see the passion and the struggle that arises when having uncomfortable and challenging conversations. Future researchers should consider how current and future students in higher education can be both effective communicators and conversationalists in both online technologies and offline technologies, as well as online and offline settings.

Lastly, future research should study the college student as a whole. Specifically, what are an incoming freshman's hopes, dreams, views, and ideologies? How does an 18-year-old see his/her place in the world and how do their social and cultural views shape their interaction and engagement with others? Generally speaking, the perspective of an incoming freshman is one of excitement, uncertainty, nervousness, and anxiety. There is pressure: pressure for grades, pressure to find the right social group, pressure to fit in, pressure to find a job, and hopefully a career. What gets lost in the higher education culture is a need for the college student to be nurtured holistically and I argue, a case for the college student to leave the university setting in four years with a better understanding of his or herself than they had upon entering. College should be a time for students to explore their ideas, to create the type of person they want to become, to learn from one another, and to engage with their peers. A larger, more existential question related to this is the overall purpose of the university experience: is it simply to earn a degree to position a 22-year-old graduate for a good paying job? Is the university setting the opportunity for an 18- to 22-year-old to create the person they want to become, after 18 years of socialization at home and in public school? Researchers should begin steering their focus on developing the mental, physical, cultural, and social well-being of the 18- to 22-year-old student who is paying thousands of dollars to earn an education. What good is a $75,000 a year job for a 22-year-old when he or she is still struggling to understand themselves and their sense of purpose? Research should now include how higher education can strike a balance between

educating the student to enter the global workplace, as well as educating the student on how to live as a happy, healthy, socially conscious, and productive citizen going forward.

Wh**at I Learned**

Students taking the STS 201 Honors course entered NJIT with limited and superficial knowledge of topical social issues. They were aware of the terms, “heard about” certain issues, and, at times, voiced perspectives that they openly admit to have read online or heard from family and friends. Students are eager to learn more about current social issues and desire to be informed. They are interested in hearing from their peers, engaging with varying perspectives, especially of those who are outside their social and cultural bubble. The conversations occurred in both large and small group settings, as well as one-on-one environments and the students acknowledged that there was a different type of learning that took place in each setting. These conversations broke students out of their respective bubbles and forced them to interact with those of opposing views and beliefs and, in return, students were self-reflective towards their own beliefs. Conversations, discussion, and self-reflection proved to be strong and effective pedagogical tools in this study. Self-reflection proved to be a learning experience in and of itself. Through the reader response/reflective writing assignments, students had the opportunity to think about their beliefs and perspectives, how it conflicts with others, and how they see the specific social issue now, after being exposed to factual data and varying interpretations.

However, not all students were as open to change as others. A small percentage of students displayed a lack of interest, care, or concern for issues outside of STEM major. One aspect of this study that I found interesting was realizing that educators cannot change how a student thinks or views the lens through which he or she see the world unless there is a willingness from the student to change within. Even though there was an eagerness, openness,

and willingness from the majority of students to listen, learn, discuss, and engage with the topics, there is still a segment of the population that sees their role at NJIT to strictly study STEM and not engage with social issues.

Looking ahead there would be a few things I would do differently next time I conduct a study like this. First, I would have a pre-survey at the beginning of the semester, rather than one survey with pre- and post-questions at the end of the module (like what was done in this study). In addition to the survey, I would conduct a focus group at the start of the semester with the same students at the end. In addition, I would restructure the content of the intervention module to provide specific cases (as I did with Superstorm Sandy and Hurricane Katrina) in which there were obvious reactions to socioeconomic inequality. In the future, rather than immediately discussing issues such as race and gender equality from the start, I will modify the module where students eventually reach conclusions by themselves and/or formulate their conclusions without my guidance or suggestions.

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Appendix A

Survey: Pre and Post

Social Justice Attitudes Scale of STEM students prior to and following an Intervention Module

This following statements ask you to indicate how *important* or how much you *value* the following activities. Please answer these questions based, not on whether you actually engage in these activities, but whether you feel that these activities are important and worthwhile. Please indicate the degree to which you either agree to disagree with the following value statements on a 7-point scale, with 1 = strongly disagree, and 7 = strongly agree.

Social Justice Attitudes subscale

Beliefs **I believe that it is important to….**	**Strongly**			***Neutral***			
	Strongly Disagree						***Agree***
1) Make sure that all individuals and groups have a chance to speak and be heard, especially those from traditionally ignored or marginalized groups.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
2) Allow individuals and groups to define and describe their problems, experiences, and goals in their own terms.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
3) Talk to others about societal systems of power, privilege, and oppression.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
4) Try to change larger social conditions that cause individual suffering and impede well-being.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
5) Help individuals and groups to pursue their chosen goals in life.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
6) Promote the physical and emotional well-being of individuals and groups.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
7) Respect and appreciate people's diverse social identities.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
8) Allow others to have meaningful input into decisions affecting their lives.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
9) Support community organizations and institutions that help individuals and groups achieve their aims.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
10) Promote fair and equitable allocation of bargaining powers, obligations, and resources in our society.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
11) Believe the importance of social justice rights of others	*1*	*2*	*3*	*4*	*5*	*6*	*7*

Perceived Behavioral Control around Social Justice	**Strongly**			***Neutral***			
	Strongly Disagree						***Agree***
12) I am confident that I can have a positive impact on others' lives.	*1*	*2*	*3*	*4*	*5*	*6*	*7*

13) I am certain that I possess an ability to work with individuals and groups in ways that are empowering.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
14) If I choose to do so, I am capable of influencing others to promote fairness and equality.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
15) I feel confident in my ability to talk to others about social injustices and the impact of social conditions on health and well-being.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
16) I am certain that if I try, I can have a positive impact on my community.	*1*	*2*	*3*	*4*	*5*	*6*	*7*

Intentions to Engage in Social Justice	**Strongly** ***Strongly Disagree Agree***			***Neutral***			
17) In the future, I will do my best to ensure that all individuals and groups in my community have a chance to speak and be heard.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
18) In the future, I intend to talk with others about social power inequalities, social injustices, and the impact of social forces on health and well-being.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
19) In the future, I intend to engage in activities that will promote social justice.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
20) In the future, I intend to work collaboratively with others so that they can define their own problems and build their own capacity to solve problems.	*1*	*2*	*3*	*4*	*5*	*6*	*7*

Pre and Post Intervention Module views towards issues of social justice, race, inequality, and socioeconomic status	**Strongly** ***Strongly Disagree Agree***			***Neutral***			
21) Before the course I believed natural disasters are isolated events that effect all people, regardless of background, equally.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
22) Before the course I believed certain people can marry each other and certain people cannot marry each other.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
23) Before the course I believe targeting individuals based on a perceived characteristics (race, religion, ethnicity) is justified and okay.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
24) Before the course I believe that hunger is an issue that impacts underdeveloped countries and not developed countries.	*1*	*2*	*3*	*4*	*5*	*6*	*7*

25) Before the course I believe as a STEM major I have the power to offset damage caused to communities and groups of people by natural disasters.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
26) Before the course I believed as a STEM major I have the power to offset gender bias and inequality directed towards certain groups based on their lifestyle.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
27) Before the course I believe as a STEM major I have the power to change how certain groups are perceived socially.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
28) Before the course I believe as a STEM major I have the power to lessen food insecurity and hunger in my immediate community.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
29) Before the course I believe as a STEM major I have the power to improve issues of social justice and social inequity.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
30) After the course I believed natural disasters are isolated events that effect all people, regardless of background, equally.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
31) After the course I believed certain people can marry each other and certain people cannot marry each other.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
32) After the course I believe targeting individuals based on a perceived characteristics (race, religion, ethnicity) is justified and okay.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
33) After the course I believe that hunger is an issue that impacts underdeveloped countries and not developed countries.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
34) After the course I believe as a STEM major I have the power to offset damage caused to communities and groups of people by natural disasters.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
35) After the course I believed as a STEM major I have the power to offset gender bias and inequality directed towards certain groups based on their lifestyle.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
36) After the course I believe as a STEM major I have the power to change how certain groups are perceived socially.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
37) After the course I believe as a STEM major I have the power to lessen food insecurity and hunger in my immediate community	*1*	*2*	*3*	*4*	*5*	*6*	*7*
38) After the course I believe as a STEM major I have the power to improve issues of social justice and social inequity.	*1*	*2*	*3*	*4*	*5*	*6*	*7*

39) I am more informed and more aware of social justice issues following the learning modules that I was before.	*1*	*2*	*3*	*4*	*5*	*6*	*7*
40) This course had a strong impact on my views towards social justice and social inequality issues.	*1*	*2*	*3*	*4*	*5*	*6*	*7*

Torres-Harding, S.R., Siers, B., & Olson, B. (2012). Development and Psychometric Evaluation of the Social Justice Scale (SJS). *American Journal of Community Psychology*, *59* (1-2), 77-88.

Appendix B

Addition Pre and Post Survey Statements

1) I believe natural disasters are isolated events that effect all people, regardless of background, equally.

2) I believe certain people can marry each other and certain people cannot marry each other.

3) I believe targeting individuals based on a perceived characteristics (race, religion, ethnicity) is justified and okay.

4) I believe that hunger is an issues that impacts underdeveloped countries and not developed countries.

5) I believe as a STEM major I have the power to offset damage caused to communities and groups of people by natural disasters.

6) I believe as a STEM major I have the power to offset gender bias and inequality directed towards certain groups based on their lifestyle.

7) I believe as a STEM major I have the power to change how certain groups are perceived socially.

8) I believe as a STEM major I have the power to less food insecurity and hunger in my immediate community.

9) I believe as a STEM major I have the power to improve issues of social justice and social inequity.

Appendix C

Focus Group Questions

1) Discuss the first topic we covered for the intervention module. What were your experiences like interview individuals that were impacted by Superstorm Sandy? What types of social problems, if any, did the flooding create in the towns they live?

   a) What were your views on Superstorm Sandy like prior to the lesson?

   b) What are your views now?

2) Let's consider your experiences regarding the content from Week 2. Specifically, profiling, discrimination, and bias. What are your views on the experience and how does it influence your perceptions on race, religion, and ethnicity?

   a) How has the lesson influenced, if at all, your understanding of race?

   b) Is bias something people can overcome?

3) What did you learn from the Week 3 topic that focused on gender issues? How does the experience contrast with your own prejudices prior to discussing the topic?

   a) What were your views on gender prior to the lesson?

   b) In what ways has your understanding been enhanced, changed, or remained the same?

4) What did you learn from the Week 4 topic that focused on LGBTQ and gender issues? How does the experience contrast with your own prejudices prior to discussing the topic?

   c) What were your views on the LGBTQ community prior to the lesson?

   d) In what ways has your understanding been enhanced, changed, or remained the same?

5) Is there any way you see the STEM fields playing an integral role in any of the issues we discussed? Is there room in the STEM curriculum to focus on issues of social justice? Should there by? Why?

Appendix D

Reflection Assignment Responses and Final Question

1) How much did you know about the topic before we started?
2) In what ways has your knowledge or perception gotten better regarding this topic?
3) How do you feel about this specific topic?
4) What did you learn about yourself as you worked on this topic?
5) Have you changed any ideas you used to have on this topic?
6) What the one thing you particularly want people to think about when they consider this topic?
7) What would you change if you had a chance to do the experience over again?

Final Reflection Response:

As a STEM student, after completion of the intervention module, please discuss how your role as a STEM major influences, change, and/or enhance issues of social justice and social inequity. In other words, do you see a connection or relationship in your current STEM field of study and issues of social justice and social inequity? Why or why not?

Appendix E

Research Reflective Interview

1) How has the experience with the intervention module going thus far?
2) What have been some of the positive and negative experiences you've encountered?
3) How do you personally feel about the content?
4) Do you find your own views on the content influencing or swaying students?
5) Are there any conflicts or difficulties you've had thus far?
6) Have there been any surprises or things that caught you off guard?
7) Overall, discuss how you think the previous week's topic went and how you think the current and future topics will proceed?