Summer 2022

The Devil and Tom Robot: The Use of Robotics to Impact Empathy in Secondary Students of American Literature

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THE DEVIL AND TOM ROBOT: THE USE OF ROBOTICS TO IMPACT EMPATHY IN SECONDARY STUDENTS OF AMERICAN LITERATURE

by

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Bachelor of Arts
Francis Marion University, 2004

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Francis Marion University, 2018

Submitted in Partial Fulfillment of the Requirements

For the Degree of Doctor of Education in

Curriculum and Instruction

College of Education

University of South Carolina

2022

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DEDICATION

In 1934, my grandma Hannah Mae graduated from Hannah High School, becoming the first woman in her family to do that. In 1940, my grandma Liz went even further, graduating from the Sinai Hospital Nursing Program, insisting she could do so even with a child at home.

Submitting this dissertation, I am acutely aware of the precedent set by these women and I am honored to be a small part of their legacy of bullheaded, rebellious perseverance.

This is dedicated to their memory, along with my daughters, who were gifted with the same fearless tenacity, and my mama and my daddy. Now you have a joy you can share at church.

ACKNOWLEDGEMENT

I am forever grateful for the love and support I have received throughout my doctoral journey. I am a different person than I was when I started, and I owe my newfound confidence to this process.

Thank you to the faculty and staff of the Educational Technology program at the University of South Carolina, especially Dr. Tang, for guiding me in the right direction and having endless patience with my questions.

Thank you to the faculty and staff of Sleepy Hollow High School, especially Mr. Mosby, who let me run wild with the robots and was endlessly supportive. Thank you to Katina Davis, Kim Jenkins, Rusty Turner, Brad Drawdy and Jamie Johnson, for believing in me and tolerating my anxiety. Thank you to Dresden Floyd, who never thought I was as dumb as I felt.

Thank you to my students, current and former, who tolerated my eccentricities, unending support, lectures on empathy and constant references to *Shrek*.

There are no words great enough to encompass what I owe my family for supporting me so that I could pursue this dream. I will try not to be too annoying about it, but I can't make any promises.

Sunshine, SarahMoon and Robin – I could not have done this without you and not a day has gone by that I am not grateful.

ABSTRACT

The purpose of this action research study was to evaluate the effect of a robotics-based intervention on empathy for students enrolled in secondary English and literature courses. Empathy, as a concept, is an integral component of reading comprehension and student motivation. A decline in reported individual levels of empathy among young adults can negatively influence longitudinal academic and career success. Robotics present a promising method in which to impact student learning in K-12 environments. Student manipulation of Wonder Workshop Cue robots in designed challenges was integrated within literature content standards for English III. The outlined study measured the impact of that intervention. The study measured student empathy levels pre- and post-intervention and gathered information related to student perceptions of the intervention.

The study used a mixed methods action research approach to impact empathy with a robotics intervention centered around Washington Irving's contribution to American Romanticism and early American literature. The study featured 13 students enrolled in English III at Sleepy Hollow High School during the fall semester of the 2021-2022 academic year. These students used robotic manipulatives to complete challenges featuring details from the text. The Interpersonal Reactivity Index was issued pre- and post-intervention. A Personal Reflection Survey was issued post-intervention. Behavioral observations and one-on-one interviews were conducted.

Quantitative findings indicated that overall scores on the Interpersonal Reactivity Index were significantly impacted. Scores on the subscale of Fantasy were also

significantly impacted. Additionally, scores on the Personal Reflection Survey indicated that participants understood the concept of empathy and the purpose of the intervention. Qualitative findings indicated that participants displayed an awareness of struggle during the intervention and responded to the struggle with empathy. Participants also developed an understanding of the robotics as an experience of embodied cognition.

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INTRODUCTION

National Context

In the eyes of Pulitzer prize-winning American novelist, Harper Lee, "You never really understand a person until you consider things from his point of view… Until you climb inside of his skin and walk around in it" (Lee, 1960, p. 33). This is the definition of empathy, despite its loose interpretation of the cognitive process. Empathy is the skill that allows us to react emotionally when confronted with the needs of others (Wilhelm & Bekkers, 2010). Empathy is a basic component of life and a basic component of social behavior, guiding the way in which we function as a global culture (Briggs, 2014). It helps us work together, cooperatively, and it helps us navigate challenges, individually (Fleming & Lovat, 2015). However, empathy is on the decline for American youth (Elmore, 2014).

In a highly publicized study at the University of Michigan (Sara Konrath et al., 2011), researchers deduced that between 1979 and 2010, students' self-reported levels of empathetic reasoning, or the cognitive process of recognizing the emotional states of others, declined by nearly 50%. Scores on the Interpersonal Reactivity Index, a standard measure of empathy, from five separate time periods (1979-1989, 1990-1994, 1995-1999, 2000-2004, and 2005-2009) were analyzed for populations of college-age young adults. A pronounced decline from 20o4 forward is apparent (Sara Konrath et al., 2011). For a variety of hypothesized reasons, it has simply become too difficult to identify with the

lived experiences of those around us and respond appropriately. Students, especially, are more likely to labor under the solitary pursuit of success (Sara Konrath et al., 2011) than to consider, deeply, the circumstances of classmates, in effect losing one of the most valuable 21st century workplace soft skills (Shwartz, 2017).

A lack of empathy, or the inability to see things from another person's perspective as stated by Lee (1960), can be attributed to a litany of negative behaviors (Peets et al., 2015). Young adults who report lower levels of empathy are statistically more likely to exhibit antisocial tendencies, rather than their prosocial counterparts (Coyne et al., 2018). These tendencies can include sexual deviance, experimentation with drugs, and acts of overt aggression, such as bullying or fighting (Sara Konrath et al., 2011; Suleman et al., 2019). For school-age students, this disruption of the classroom environment impedes the process of learning (Peets et al., 2015). Therefore, the largest arena in which to discuss the ramifications of empathetic decline is within the sphere of education (Blumberg et al., 2019).

While whole group culture and the general atmosphere of learning in schools are affected by stunted empathy levels in students, the deficit of empathy also directly relates to the domain of reading comprehension (Gillioz et al., 2012). This multifaceted, intricate and multidimensional ability includes varying levels of cognitive engagement and a myriad of cerebral skills (Elleman & Compton, 2017). One of these skills is the executive function of crafting mental images of both physical and emotional events described in the text (Elleman & Compton, 2017; Gillioz et al., 2012). From these images, or rough sketches of emotional context, as readers, students must make inferences and predictions about motives and plot (Department of Education, 2018; Gillioz et al., 2012).

Additionally, students rely on empathy to determine characterization techniques, tone and mood (Department of Education, 2018). Readers who are unable to project through the process of empathetic reasoning are less likely to decode complex elements of literature properly (Elleman & Compton, 2017). This inability correlates to a documented decrease in overall reading scores for the United States, as indicated by the Pew Research Center (Desilver, 2017).

Across the country, the average verbal score on the SAT, or Scholastic Aptitude Test, has plummeted from 479 in 1956 to 425 in 2006 (Jameson, 2007). This is due, in part, to substandard abilities in regard to verbal decoding and critical thinking as they correspond or interrelate to complex literary texts (Elleman & Compton, 2017; Jameson, 2007). A shortcoming in empathetic reasoning proves to be a hindrance to the success of students causing a language deficit and a lack of genuine synthesis of provided text (Catts et al., 2006). It is accepted that the more empathetic a reader, the higher the complexity of what can be amalgamated; conversely, the less empathetic the reader, the lower the complexity of what can be understood and the lower the performance on standardized assessments set to measure true academic synthesis of issued content standards (Gillioz et al., 2012).

Local Context

Comparatively, South Carolina is ranked 41st in relation to public education, educational spending, and education policy (Stebbins & Frohlich, 2018). The National Education Association scores South Carolina as 23rd in fall enrollment for 2018 (National Education Association, 2018); overall, the state has the 18th lowest graduation rate and the 20th lowest per-pupil spending (Stebbins & Frohlich, 2018). On the 2017 spring

standardized assessments, 27.8% of South Carolina's eighth-graders were considered *proficient* in reading, approximately 4.9% below the national average of 32.7%. Using that as a barometer, 72.2% of the state's 2017 eighth-graders were not proficient in reading prior to matriculation in public high schools. Tarry Town County, South Carolina, is home to seven such high schools in five individual districts (florenceco.org, 2021).

The Tarry Town School District is located in Tarry Town, South Carolina, a rural agricultural community (Florence County School District Two, 2018a). The incorporated town of Sleepy Hollow has a population of 1,231, while the outlying communities of Hannah, Salem, and Gresham have no formal census data available (United States Census Bureau, 2019). There are two schools in the district, Sleepy Hollow Elementary / Middle School and Sleepy Hollow High School (florenceco.org, 2021). Approximately 1,142 students are enrolled in FSD2, spanning 4K through 12th grade (South Carolina Department of Education, 2019a). Student athletes compete on the A level in all varsity and junior varsity sports (South Carolina High School League, 2018).

Sleepy Hollow High School is the smaller of Tarry Town School District's pair of facilities, maintaining a student population of 364 and a staff population of 29 (South Carolina Department of Education, 2019a). The institution offers courses to meet all graduation requirements in the state of South Carolina as well as numerous dual credit opportunities administered through Tarry Town Technical College and Francis Marion University (Florence County School District Two, 2018b). On the 2019 South Carolina State School Report Card, Sleepy Hollow High School earned an average rating with weaknesses in the domains of Preparing for Success and Graduation Rate but strength in

the domain of College and Career Readiness. Academic Achievement was rated average. English Learners' Progress was not rated (South Carolina Department of Education, 2019a). The overall distinction of average is a drop in the scores of previous years, with the 2012 score of excellent serving as a highpoint. A score of good followed in 2013 (South Carolina Department of Education, 2019a). Lowered SAT and ACT performance, particularly in the area of reading comprehension, have played a role, as has a dip in End of Course assessment scores in English and language arts.

Per state guidelines for accreditation, all students within Sleepy Hollow High School must complete four levels of English and language arts instruction during the standard four-year high school experience (Florence County School District Two, 2018b). For most, this instruction begins in ninth grade with English I and culminates in English IV taken during the student's senior year. Of these four prescribed levels, one End of Course assessment is issued at the close of English II. Required assessments for college acceptance – the Scholastic Aptitude Test, or S.A.T., and the American College Test, or A.C.T. – are issued at the close of English III. Over the course of the last five years, student performance on said assessments has dropped by nearly five percentage points between the 2017 and 2019 academic years (South Carolina Department of Education, 2019b). This weakening mirrors the reduction in empathetic reasoning among young people (Gillioz et al., 2012). A pronounced Covid decline could only exacerbate the problem.

As an English instructor at Sleepy Hollow High School, I teach the only English III course offered in the Fall. The predominance of students in this course are on the junior level, in eleventh grade, ranging from 16 years of age to 20 years of age. Across

the board, I see students in every level of literature grapple with the analysis of complex text. In English III, specifically, this extends to the analysis of seminal U.S. historical documents. I see their frustration grow, not when confronted with unfamiliar or higher-level vocabulary terms, but more when they cannot understand the motivations of characters described or politicians featured. I see them apathetic when horror and sadness and strife are narrated, and equally detached when protagonists triumph. This betrays a distinct inability to put themselves in the shoes of another and anticipated reactions when confronted with emotional context.

Statement of the Problem

Empathy, or a sense of emotional awareness for others, has long been considered a deeply embedded, or fixed characteristic, one all humans are born with (Lasley, 2017); however, today's college students report a significant decline in empathetic reasoning abilities, or the ability to recognize when empathy is necessary, as compared to their predecessors of the 1970s (Konrath et al., 2011). This deficiency has become more evident as the age of technology unfurls, with an identifiable drop coinciding with the year 2000 (Bryner, 2010). In a secondary English literature classroom, a disconnect from the outside world, and an inability to make connections through shared experiences affect academic performance (Crowley & Saide, 2016). A decrease in a student's empathetic reasoning ability leads to a decrease in reading engagement causing reading and literacy skills to suffer across the board (Zaki, 2011).

As an English literature instructor, I have seen firsthand the slow recession of empathetic tendencies in young people. Students at Sleepy Hollow High School do not empathize with characters in the complex literary text. Nor do they empathize with

politicians and historical figures associated with the founding of the United States – a required standard for the instruction of American Literature. Because of this, true understanding of the printed word is lacking which is subsequently detrimental to reading comprehension. The field of educational robotics has been found to increase problem-solving skills and cognitive flexibility, which can be used to impact reported student empathy levels when implemented even in a literature classroom (Di Lieto et al., 2017).

Purpose Statement

The purpose of this action research study was to evaluate the effect of a robotics-based initiative on empathy for students enrolled in English III at Sleepy Hollow High School.

Research Questions

1. How does the use of robotics impact Sleepy Hollow High School English III students' levels of empathy?
2. What are student perceptions of the use of robotics in the English III classroom at Sleepy Hollow High School to impact empathy?

Statement of Researcher Subjectivities and Positionality

Subjectivities

I decided to pursue a graduate degree in educational technology for two distinct reasons. I wanted to better my practice as an educator, working in a district with ample opportunities for technology integration available. Also, I wanted to step into a leadership position within the English and literature community, pairing with other ELA teachers to aid in effective technology integration for that context, specifically.

I would describe my ideal educational technology professional as cutting edge and dynamic. I think the technology presented to faculty and staff in public schools should be substantive and content relevant rather than superfluous, acting as technology simply for the sake of utilizing technology. I think an educational technology professional should be able to tell me something I do not already know and something that I cannot easily find on my own. Educational technology professionals should also be purposeful in their presentation of concepts and tools.

Personal characteristics I have that make me an "ideal" educational technology professional are a drive to research and present new and different ways of doing things. I feel this is primarily evident in my constant research for those in the English department, so often underserved by the bulk of the technology innovations presented in professional development. I grew up in a rare and specific timeframe, having an analog childhood and digital adulthood, giving me a unique perspective on precisely how beneficial technology can be when implemented appropriately. Conversely, one personal characteristic I have that presents a challenge to my future as an educational technology professional is my refusal to accept some of the difficulties teachers associate with technology. My belief is that if you cannot stop the train on the tracks and you cannot go backward in time to fully embrace an antiquated method of standards dissemination, you have no choice but to adapt.

Professional characteristics I have that make me an "ideal" educational technology professional include my role in the technology implementation team within Tarry Town School District and my attendance and participation in regional technology conferences. I have presented at the South Carolina Council for Teachers of English

twice, displaying technology-based initiatives that strengthen students' abilities to dissect complex literary text using infographics and interactive plot diagrams. Additionally, I have been a workshop presenter at the South Carolina Educational Technology Conference and I have conducted one-on-one training with other area educators.

Two challenges to my future as an educational technology professional are my career in a rural setting with limited access to technology and stable, highspeed internet, and my lack of professional experience, in general, having been in the classroom for less than fifteen years.

Through my research, I am interested in learning more about teens and their emotional or empathetic processing skills. I am equally interested in determining whether technology can effectively be actualized as a vehicle to target and enhance these skills. Overwhelmingly, much is known about the social consequences of technology (Kocaman et al., 2017). I would like to research the opposite side of the spectrum.

My research paradigm is the pragmatic paradigm. This paradigm focuses on the practical or common sense aspects of research application rather than any theoretical implications (Morgan, 2014). I find it is more of a workable paradigm and one that will allow me to seek out the solution to a discernible problem of practice (Feilzer, 2010).

Within my research, my positionality is that of an insider studying my own practice. The intervention designed to enhance my students' identified levels of empathy will be put in place and measured in the context of my classroom. This will add to the overall knowledge base of my field and could potentially lead to transformation. To negotiate this, I will need to make my role as a researcher and the ultimate goals of the study clear from the start. There is the potential for me, as the teacher and the researcher,

to synthesize results in a purely positive manner, and I will need to evaluate my own bias at each level in order to avoid this. I will also consult and seek guidance from industry professionals and my dissertation committee.

My research paradigm relates to educational technology in a concrete and hands-on way. Pragmatism operates on the notion that the "truth" sought from research can be found in the solutions to identified problems (JA et al., 2010). The problem identified, in my case, is my students' inability to emotionally connect with characters in the complex literary text due, in part, to decreased levels of empathy. The solution would then be designing technology-based interventions to boost or facilitate the strengthening of identified levels of empathy.

I feel that my research will be aided and reinforced by my worldview, my beliefs about teaching and learning, and my expertise in the field. In the future, I see seamless integration with technology that leads to global connectivity and constant collaboration. This will cause me to move doggedly forward with plans of technology implementation in spite of the negatives some attribute to the addition. I also do not believe that the process of teaching and learning should be confined to the physical classroom or to the prescribed timeframe of eight a.m. to three p.m. Learning should be more organic and should include soft skills, ultimately reaching all students. This will cause me to develop interventions that serve the student population, as a whole, rather than only those who thrive in traditional environments. My expertise as a regular-education teacher, a teacher for gifted students, and my background in special education will aid in my delivery of the interventions while my experience in an alternative setting will increase my drive to connect the interventions and learning to the personal lives of the students on my roster.

Limitations of my research can occur when considering the length of my career as an educator. I have been a teacher for less than fifteen years and have worked in several schools, teaching a variety of subjects. I also tend to view opponents to full and appropriate technology integration in the field of education as "old school" or "rigid," and I have limited technology credentials. My learning, for the most part, has been self-taught and hands-on.

Positionality

Presently, I am an English and literature teacher with twelve years of experience in the classroom. I am certified to work in the secondary education environment, although I have experience in the middle grades as well. I am endorsed to teach Gifted and Talented populations as well as populations of struggling readers. I hold a Master of Education in Instructional Accommodation, which falls under the umbrella of special education. I have worked in both traditional classroom settings and the alternative or punitive environment. I am bilingual and have taught the Spanish language as well as United States History, World Geography, and Comprehensive Health. I work for my alma mater – a rural, public high school in South Carolina.

Growing up and subsequently working in a small, pastoral town has given me two distinct lenses through which to view teaching, learning and technology. Firstly, I use the lens of my childhood: a childhood that occurred immediately prior to the advent of widespread internet usage. The process of my education seemed to occur, then, with very little influence or interference from more progressive, nontraditional, project-based approaches. Teaching took place at the front of the classroom and learning took place while safely seated in a desk. There were no accommodations for students whose learning

profiles differed from the accepted norm, and that was thought to be the way of the world. High achievers were filtered into one group and labeled Honors, average students were funneled into a College Prep track, and low performing or struggling students were considered Tech Prep and taught the bare minimum of content standards.

The second lens I use is the lens of my adulthood and my professional career as an educator. While the town is still incredibly rural and, thusly, somewhat isolated from the developments and routines of major cities, the advent of widespread internet usage promotes a degree of global connectivity where I see great potential and promise. My students are more exposed and more informed than students of generations past and can bring more to the table. The downside of this, of course, is the tendency for students to emotionally disconnect from the world around them and lose valuable empathetic processing skills (Manney, 2015).

These lenses give me a decidedly pro-technology bias. I have seen the changes in the same town both pre- and post-internet, and I weigh the benefits of access and improvement more heavily than the negatives. My students are well-rounded and more equipped with 21st-century soft skills that are components of a successful high school graduate (Department of Education, 2018).

I identify strongly with the pragmatic research paradigm. I tend to believe that research should be action-based and should support the solving of problems (Morgan, 2014). In this view, all research should be practical rather than merely descriptive (Feilzer, 2010). Pragmatic researchers are not encumbered by lengthy ontological conversations about multiple realities and epistemology (Davies & Fisher, 2018). Instead,

I see the end goal of my research as determining an effective solution to one issue I see in my sphere of influence.

In regard to my research, I have the positionality of an insider studying my practice in the classroom. I hope to design a robotics-based initiative that facilitates the strengthening of empathetic processing skills for students enrolled in English III. This would then translate to an increase in the students' abilities to emotionally connect with characters in complex literary texts.

Definition of Terms

Robotics

Robotics or robots refer to the Wonder Workshop Cue educational robotic manipulatives. These robots are dependent upon user control and/or programmed movement design. Students will control the robots to accomplish outlined tasks supervised by the instructor. The outlined tasks provided to students will center around details surrounding the literary period of American Romanticism, American author Washington Irving and three Washington Irving short stories: *The Devil and Tom Walker, Rip Van Winkle* and *The Legend of Sleepy Hollow.* By focusing the activities around nonhumanoid robotic manipulatives as opposed to robotics designs more human in appearance, students are more likely to respond in a positive fashion to the implementation, itself, and bypass the natural reticence associated with the anthropomorphism of mechanics (de Jong et al., 2019; Mende et al., 2019; Thompson, n.d.).

Empathy

Empathy refers to an emotional capacity to see beyond one's current situation and draw compassionate parallels between personal circumstances and the lived experiences of others (Casale et al., 2018). The process of demonstrating empathy is reliant upon one's capability to distinguish and extend emotional support toward others (Young et al., 2018). In the context of this study, the phrase *empathy* is operationalized to encompass the individual student's readiness to manifest deep feeling and care for characters in the

complex literary text. Empathy also dictates how well students make connections between the events described in text and human events.

Empathetic Reasoning

Empathetic reasoning refers to the cognitive process of recognizing the emotional states of others. It is one of the two domains of empathy (Menolascino & Jenkins, 2018). It is the cerebral component of understanding the processing the needs and feelings of peers.

CHAPTER 2

REVIEW OF LITERATURE

Introduction

In his critically acclaimed 1952 work, *East of Eden*, American novelist John Steinbeck summed up the concept of empathy by stating "You can only understand people if you feel them in yourself" (52). This notion, underscored by its position in literature, highlights two separate and yet intertwined deficits plaguing adolescents. The current generation of learners is both statistically less empathetic than counterparts in previous years and statistically less literate (Sara Konrath et al., 2011; Zebroff & Kaufman, 2017). Nowhere is this dual decline more evident than in a secondary literature classroom.

Without an understanding of empathy, students are at a loss when confronted with complex literature. The innate ability to extend compassion beyond the immediate self and consider the perceptions and lived experiences of others is compromised. Therefore, students are unable to deduce motivation, tone and character development in text. This compounded lack of understanding has dire effects on both social and academic performance, setting students up for longitudinal failure (Suleman et al., 2019).

Many factors contribute to the shortfall of both empathy and reading comprehension in American young adults. The most prevalent of these factors is the pervasive use of technology (Ernst & Moye, 2013). Mobile games, applications, social media outlets, simulations and robotics have in a sense, reshaped the way society

functions, collectively and individually (Boren, 2015). When one considers the rising rates of functionally illiterate citizens in industrialized countries with ready access to technology, a dearth in the areas of reading comprehension and reading comprehension as it relates to empathy and technology must be addressed by research (Zebroff & Kaufman, 2017). This review of literature seeks to address the connections between student empathy and technology integration in order to answer the following research questions:

1. How does the use of robotics impact Sleepy Hollow High School English III students' levels of empathy?
2. What are student perceptions of the use of robotics in the English III classroom at Sleepy Hollow High School to impact empathy?

The purpose of this action research study is to evaluate the effect of a robotics-based initiative on empathy for students enrolled in English III at Sleepy Hollow High School. In order to support the initiative, a systematic review of available research was conducted using two distinct search engines. Identical phrasing was used in both, in order to pinpoint items that directly pertained to the concepts that formed the basis for a robotics-based initiative designed to impact student empathy in a high school literature classroom. Those specific concepts were empathy, challenges and initiatives to foster empathy, reading comprehension in young adults as it relates to empathy, parameters of effective technology integration in the classroom, embodied cognition, and the significance of technology and robotics technology as they correlate to empathy. Approximately 72 articles were reviewed by the researcher between September 22, 2020 and April 30, 2022. These articles were organized by theme. The four themes used to

categorize the articles were Empathy and Emotional Intelligence, Emotional Intelligence and Reading Comprehension, Robotics and Parameters for Effective Robotics Interventions.

This review is comprised of three primary sections. The tie between emotional intelligence and academic success is outlined first. In this section, the role of emotional intelligence in reading comprehension is highlighted. Following, the domain of empathy is defined in detail and the current decline of empathy is addressed. Initiatives and interventions aimed at impacting empathy are also discussed. Finally, the concept of robotics as an empathy intervention is dissected. The theoretical foundations for this are provided, components of effective robotics interventions are listed, support for robotics as a means to incorporate embodied cognition in the classroom are discussed and existing research is synthesized. Challenges, as well as disparities in research are also noted throughout.

Emotional Intelligence and Academic Success

Emotional intelligence, or E.I., can be defined as the "capacity to perceive and assimilate emotions, understand the implications of those emotions and manage them" (Urquijo et al., 2019). This complex skillset allows human beings to build better relationships, navigate difficult social situations, view and enjoy scripted media and achieve personal and professional success (Lopes et al., 2016; Mayer et al., 2008). It also positively correlates to increased academic performance across the board. In this section, the link between emotional intelligence and academic achievement is delineated specifically as it relates to the domain of reading comprehension.

Reading Comprehension

Reading comprehension is the cornerstone of education. This phrase refers to the process of amalgamating words in print in order to withdraw greater textual meaning (Hulme & Snowling, 2011). It is larger than phonics and word recognition and requires an extraction, along with the ability to take what is gleaned from a passage and use it to meld prior knowledge with tasks at hand (Vilenius-Tuohimaa et al., 2008). This forms the basis of multidisciplinary performance (Wolters et al., 2014).

Reading comprehension skills are the largest scholastic factor affecting the longitudinal performance of American high school students (Troyer et al., 2018; Wigfield et al., 2016). Between the ages of 14 and 18 formal academic success is almost entirely dependent on a student's ability to effectively summarize information in written form (Wolters et al., 2014). This complex skillset transcends grade levels, disciplines and subject areas, impacting performance across the board (Vilenius-Tuohimaa et al., 2008). Without it, young people cannot critically evaluate information of any kind or solve intricate, multifaceted problems (Avsec & Jamsek, 2016). This adversely affects mastery in science, mathematics, history and vocational courses in addition to courses rooted in literacy (Avsec & Jamsek, 2016; Vilenius-Tuohimaa et al., 2008).

Students who can read and write effectively outperform those who cannot in infinite environments. They are statistically more likely to demonstrate higher levels of mathematical reasoning (Vilenius-Tuohimaa et al., 2008). They demonstrate flexibility and insight in science and engineering; they are able to make inferences based on provided information and determine steps needed for future action or further review (Wigfield et al., 2016). Developing and strengthening this precise skillset should be

paramount in the minds of educational researchers and activists. This singular ability alone forms the fundamental bridge between the lower levels of Bloom's Taxonomy and the higher orders of apply and evaluate (Spence, 2019).

The ability to critically think, fostered by the tenets of reading comprehension, also lends itself to career development and marketability. The "hierarchical nature" of reading comprehension indicates that skills build on one another; those with higher skillsets have invested more time in skill development and are subsequently more marketable (Wigfield et al., 2016). Additionally, the cognitive domain accessed by critical thinking, knowledge and understanding is in demand for jobs and trades within the technology and vocational sectors (Avsec & Jamsek, 2016). Jobs in these fields will employ more and more workers in a globally collaborative future.

Emotional Intelligence and Reading Comprehension

The ability to deduce emotions, emotional signals and the emotional implications of our decisions directly corresponds to reading comprehension in adolescents (Mayer et al., 2008; Urquijo et al., 2019). This understanding of the thoughts and lived experiences of peers and others renders the processes of dissecting character development and discerning character motivation a fluid cognitive motion (Ampuero et al., 2015; Gillioz et al., 2012; Rantala et al., 2016). It is also elemental in making inferences based on evidence presented in written form (Gernsbacher et al., 1992; Gillioz et al., 2012). An absence of these emotional reasoning skills, by extension, has a negative effect on literary decoding. A deficit of emotional intelligence, then, inhibits a student's ability to deduce author's tone and point of view and, subsequently, determine the effects of that on

literary works in their entirety. This adversely impacts reading proficiency as it relates to assigned content standards (Department of Education, 2018).

Reading is related to social competency in three key ways: it simulates the real-world and, thereby, allows the readers to extend beyond themselves, it elicits emotion and emotional response and it trains the reader to make inferences about future plot developments (Kozak & Recchia, 2019). This transaction with the text is a pedagogical strategy that activates the same areas of the brain stimulated by the act of understanding other people (Oatley, 2016; Schieble & Kucinskiene, 2019). In this way, emotional intelligence is the key cognitive variable in mastering comprehension of complex literary text (Dohrenwend, 2018; Yuan, 2018). Further, the correlation outlined between the overall effects of emotional intelligence on academic success can be firmly rooted in the concept's ties to stronger reading comprehension skills, which transcend discipline and grade level (Froiland & Davison, 2019).

There are strong ties between emotional intelligence and social understanding and the mental process of synthesizing fictional text (Kozak & Recchia, 2019; Schieble & Kucinskiene, 2019). The ability to analyze and relate to a character's emotions plays an integral role in mastering the content standards for English and language arts from grades nine through 12 (Department of Education, 2018; Yuan, 2018). Students must extend beyond themselves to consider the lived experiences and points of view of authors and characters, dissecting motivation and intention in order to hone the skills of inference and prediction (Department of Education, 2018; Oatley, 2016). Without these skills, there is no true knowledge constructed but only the perception of "indifferent, meaningless signs" (Yuan, 2018). Individual South Carolina College- and Career-Ready Standards for

English and language arts identified as requiring heightened emotional intelligence and empathetic awareness are listed in Appendix A.

Empathy

The umbrella of Emotional Intelligence, as a field of study, envelops theories and models founded on the notion that better understanding of emotion in one's self and others inevitably leads to higher satisfaction levels and increased success in personal and professional domains (Mayer et al., 2008; Schutte & Loi, 2014). It has been defined by researchers Petrides and Furnham as "a constellation of behavioral dispositions and self-perceptions concerning one's ability to recognize, process, and utilize emotion-laden information" (Mayer et al., 2008; Petrides & Furnham, 2001). This so-called "constellation" encompasses any and all manifestations of social and peer awareness, including empathy (Mayer et al., 2008).

Empathy is an intricate behavioral construct that impacts academics, though it is declining among modern students; however, initiatives have been shown to positively impact reported empathy levels. In this section, empathy is defined and the dual domains of empathy are identified. Empathy's effects on academic performance are outlined, and the current decline in empathy among adolescents is highlighted. Initiatives to impact empathy in the classroom are also described.

Defining Empathy

Emotional Intelligence is generally considered an amalgam of the abilities to discern, comprehend and govern emotions in ourselves and in others (Schutte & Loi, 2014). This fusion of skills allows one to develop higher consciousness in social situations (Mayer et al., 2008; Schutte & Loi, 2014). The Bar-On model takes this

definition one step further by separating Emotional Intelligence into four distinct dimensions (Bar-On, 1997; Parker et al., 2004, 2017). Stress management is our ability to delay impulsive behavior and cope with anxiety. Adaptability is our inclination to adjust personal emotional states due to shifting circumstances. Intrapersonal is our identification and understanding of our own feelings and interpersonal is our identification and understanding of the feelings of others (Bar-On, 1997; Parker et al., 2017). Empathy constitutes the fourth domain.

The modern idea of empathy originated in the late nineteenth and early twentieth centuries, the product of a German term, *Einfuhlung* (Cuff et al., 2014). This phrase, coined by Robert Vischer, commonly applied to art and the aesthetic experience (Ganczarek et al., 2018). It came to be translated as "feeling into", denoting a projection of emotion beyond the self (Decety & Lamm, 2006; Goldie, 1999). This projection could be extended to human and nonhuman entities alike, allowing connoisseurs of Impressionism to fully appreciate the emotional connotations of exhibited work (Ganczarek et al., 2018). Within the parameters of social and behavioral science, empathy is typically considered the neural process of perceiving the emotional state of another and imagining a personal response based on that specific point of view (Goldie, 1999; Riess, 2017). However, inconsistencies amongst accepted scientific definitions are prevalent.

Generally speaking, the act of empathizing involves first a recognition of the emotional state of another (Goldie, 1999). This is a decidedly cognitive process that relies heavily on innate emotional intelligence (Jacob et al., 2016). What then follows is an "other-oriented social emotion" that involves sharing in the identified emotional state (Decety & Lamm, 2006). This sharing is the result of a "neural relay mechanism" that

engages the brain in parroting, or mimicking, what is witnessed in another (Riess, 2017). The emotional bridge created by this twofold act leads to a broader understanding of what experiences are like for others and an increase in compassionate, prosocial behaviors (Goldie, 1999; Riess, 2017).

Cognitive and affective empathy.

The separate processes that culminate in the behavioral concept of empathy are labeled *cognitive empathy* and *affective empathy* (Cuff et al., 2014; Lucas-Molina et al., 2017). The first of these – empathy on a cognitive level – relates to an individual's ability to identify and appropriately describe the emotions of other people (Casale et al., 2018; Cuff et al., 2014). This is frequently considered the "hardwired" aspect of empathic demonstrations, the innate product of social evolution (Ganczarek et al., 2018; Riess, 2017). The second process – empathy on a responsive level – relates to the act of showing compassion and concern that is evoked by the emotional understanding (Cuff et al., 2014). This is frequently considered the teachable element of empathic demonstration, a coachable aspect of outward expression (Riess, 2017). Both cognitive empathy and affective empathy can exist individually; however, it is the handling and placement of cognitive elements that produces the affective elements (Cuff et al., 2014; Lucas-Molina et al., 2017).

Empathy's Effects on Academic Performance

Both cognitive empathy and affective empathy correlate to academic success (Ampuero et al., 2015; Jiang & Wang, 2018; Suleman et al., 2019). In fact, empathy is the largest social factor affecting the success of U.S. high school students (Lopes et al., 2016; Song & Shi, 2017). The effects of heightened emotional awareness spans grade

levels and subject areas (Andolina & Conklin, 2018; Jiang & Wang, 2018; Rantala et al., 2016; Suleman et al., 2019). The soft skill of putting oneself in the shoes of another dictates how young people with and respond to peers (Casale et al., 2018).

On the affective side, high levels of empathy improve communication between classmates, foster understanding of material and promote the free exchange of ideas (Ampuero et al., 2015; Andolina & Conklin, 2018; Jiang & Wang, 2018). This directly addresses content standards as they change to include inquiry-based components which require students to consider alternate viewpoints (Rantala et al., 2016). Additionally, students with heightened cognitive empathy are more able to think critically and problem-solve, developing what is known as "socio-cognitive competence" (Ampuero et al., 2015). This skillset proves to be a boon in courses that hinge on a broadening, cultural understanding, like foreign language, world history and world geography (Jiang & Wang, 2018).

Increased empathy also translates to increased academic mastery and achievement. There is a pronounced correlation between emotional intelligences, like empathy, and both academic and career success (Parker et al., 2004). Students who routinely display or demonstrate empathy are more likely to be engaged in provided material, regardless of course or topic (Andolina & Conklin, 2018). They are also able to analyze multiple perspectives (Rantala et al., 2016). They have better adaptation mechanisms and are better able to fully commit to programs and have healthy stress management mechanisms (Suleman et al., 2019). This ensures achievement in the present and further down the road, though a disparity arises when one considers varying cultural norms of emotional expression (Lopes et al., 2016). Despite that discrepancy, however,

emotional intelligence is considered a better predictor of future achievement than the standard IQ score (Parker et al., 2004).

Current Decline of Empathy

Although empathy is imperative for achieving social and academic success, rates of self-reported empathy are on the decline (Hojat et al., 2004; Konrath et al., 2011; Neumann et al., 2011). In a 2011 study, researchers from the University of Michigan conducted a meta-analysis of 72 questionnaires submitted by college students between 1979 and 2009 (Konrath et al., 2011). Samples collected as part of the study involved the completion of four subscales of the Interpersonal Reactivity Index, or IRI. The IRI is considered to be the most "widely-used" measure of empathetic understanding and response in the population aged 12 and older (Lucas-Molina et al., 2017).

Designed in 1980, the IRI was created to gauge both cognitive empathy and affective empathy using four subscales (M. Davis, 1980; Lucas-Molina et al., 2017). The subscales of Empathic Concern (EC), measuring feelings of compassion and sympathy for others, and Personal Distress (PD), measuring feelings of worry during crisis situations, represent affective empathy (M. Davis, 1980; Wang et al., 2020). The subscales of Perspective Taking (PT), measuring the ability to shift from personal perspectives to those of others, and Fantasy (FS), measuring the ability to become absorbed in the lives of fictional characters, represent cognitive empathy (M. Davis, 1980; Wang et al., 2020). Evaluation of the 72 variants indicated a "stark" drop in the area of Empathic Concern, at 48%, and a noted drop in Perspective Taking, at 34% (Sara Konrath et al., 2011). These findings establish that young adults are lacking in both cognitive empathy and affective empathy over a 30-year time span.

Reading comprehension can be negatively affected by a decline in empathy.

There are many factors contributing to the decline of reading comprehension abilities in American students. Ethnicity and socioeconomic status affect language acquisition and language fluency (Wigfield et al., 2016). Gender affects reading motivation and reading regularity (Wolters et al., 2014). Technology exposure has limited the attention span and reshaped communication on very basic levels (Boren, 2015). In addition, a drop in reported levels of empathy impact student synthesis of complex literary text (Gernsbacher et al., 1998; Gillioz et al., 2012; Kozak & Recchia, 2019).

Initiatives to Improve Emotional Intelligence and Empathy

While empathy is on the decline, there is significant evidence that argues it can be positively affected by outside influences due to the mutability of the concept (Riess, 2017). Social-behavioral initiatives and training can be successfully implemented to influence each domain of empathy (Cuff et al., 2014). In regard to the cognitive component, students can be trained to recognize emotions in peers and outsiders. This is addressed in classrooms, workspaces and by counselors in one-on-one scenarios (Casale et al., 2018; Franck, 2013). Initiatives to impact cognitive empathy employ a variety of activities including traditional lecture-style presentations, analysis of provided personas and intense study of opposing cultures (Gurung et al., 2017; Jacobs & Walsh-Dilley, 2018; Sarraj et al., 2015; van Rooij, 2012). Even art therapy is used to engage and foster a sense of emotional comprehension (Ziff et al., 2017).

The affective component of empathy is addressed in an array of circumstances as well. Drama is one avenue through which learners or participants are confronted with appropriate empathetic methods of response (Gascon, 2019). Communication skills can

also be taught, in order to provide students with a scaffold of what empathetic demonstration should look like (Gurung et al., 2017; Jacobs & Walsh-Dilley, 2018). This can be presented in courses, or during individualized experiential actions, like service learning (Jacobs & Walsh-Dilley, 2018).

Another, less explored, method of guiding or impacting empathy is through the use of technology interventions. These run the gamut of mobile applications and games, to simulations and online instructional modules (Bachen et al., 2012; S. Konrath et al., 2015; Papoutsi et al., 2018; Pulman et al., 2012; Zappile et al., 2017). Harnessing the power of what is already readily available to American consumers of all ages ushers in the potential to effect larger change on the world. Individuals are able to synthesize information presented in a technologically sound format. Information presented in a technologically sound format can inspire empathy and guide empathetic response. Therefore, devices and programs rooted in technology can be utilized in initiatives to affect empathetic development.

Robotics and Empathy

Robots can be loosely classified as machines designed to carry out human- or animal-like functions with greater speed, strength and accuracy (Whitesides, 2018). The word, itself, was coined in 1920 by the brother of Czech playwright, Capek, and loosely translates as “forced labor or slave” (Glaskin, 2012; Mordoch et al., 2013). In dramatic form, Capek depicted them as sentient beings who would go on to rise up against their human controllers (Mordoch et al., 2013). One hundred years later, however, robots and the field of robotics play a pivotal role in nearly all aspects of life, from manufacturing and retail to construction, design and healthcare. Their presence is nearly as ubiquitous as

the cellular technology current communications systems depend on. We rely on them for assembly line production, engineering, personal shopping and even intricate surgical procedures (Bertacchini et al., 2017; Madakam et al., 2019; Sullivan & Bers, 2019; Szold et al., 2014). We also increasingly rely on them for care and emotional support (Mordoch et al., 2013).

There is scant research on the implications of using robotics as an intervention specifically to impact empathy in secondary literature students; however, there is information regarding the use of robotics in empathy training activities. In their capacity, they suggest that a definitive connection can be made between robotics and empathetic awareness. Robots can be used to bring about empathetic shifts using a constructivist approach, despite gaps in existing research and challenges. In this section, the use of robotics as empathy influencers is outlined, theoretical foundations for using robotics as an intervention are described, robotics-based initiatives in public education are discussed, components of effective robotics initiatives and support for the use of robotics as a means to foster embodied cognition are provided. Challenges to such initiatives are also outlined.

Assistive Robotics

By the year 2050, 115.4 million people worldwide will suffer from Alzheimer's and dementia-like illnesses, costing in upwards of $153 billion dollars annually (Mordoch et al., 2013). This increase in elderly citizens suffering from the loss of social and cognitive skills combined with the exorbitant costs of maintaining autonomous or semi-autonomous lifestyles has led researchers and healthcare professionals alike to explore the potential of assistive robotics as care aids for geriatric patients (Patrizia Marti &

Stienstra, 2013; Richert et al., 2018). These socially assistive interactive robots take various forms, including dogs, seals and cats (A. Campbell, 2011; Kramer et al., 2009; Libin & Cohen-Mansfield, 2004; Wada et al., 2008). They function as expanded therapy and promote both communication and response (Jung & Won, 2018; Mordoch et al., 2013). This therapy is designed to maximize the human / robot relationship and encourage the demonstration of empathy through "rich and meaningful" verbal and nonverbal interactions (Patrizia Marti & Stienstra, 2013). The therapy subsequently promotes social skills and cognitive processing together, as one seamless motion (Scassellati et al., 2018). Promising findings within the vein of psychogeriatric research affirm that robots can be used beyond this scope to impact empathetic reasoning among other populations.

Theoretical Foundations for Using Robotics as an Intervention

The idea of 'constructivism' is rooted in the understanding that learning is an active process of combining new information and existing understanding in order to attain real knowledge (Ștefan, 2017). This theory emerged in the 1970s and 1980s as a stark contrast to the accepted information transfer model. This widely used model indicated that neural pathways were created simply by information dissemination (Talja et al., 2005). Jean Piaget and George Kelly postulated that real synthesis occurred only after meaning was created on the part of the learner through creation of mental models of past experiences (Ștefan, 2017; Talja et al., 2005). This process underscores that learning is more meaningful when connected to life outside the physical parameters of the space where instruction occurs (Alimisis, 2019).

Robotics-based interventions are primarily constructivist in nature (Castro et al., 2018; Di Lieto et al., 2017). They are often designed with practicality in mind (Alimisis, 2019). They have an emphasis on day-to-day problem-solving and the critical consideration of issues within practice (Cho et al., 2017). They are also iterative and require continuous collaborative investigation which bolsters cognitive development (Alimisis, 2019; Cho et al., 2017). This suits the notion of continuously progressing robotics development well. Additionally, robotics is a tactile field of study in which comprehension is facilitated through the movement of abstract ideas becoming concrete processes, which encourages transfer (Di Lieto et al., 2017). Knowledge, in the sphere of robotics, is created through direct action but fortified as the result of continuous experience (Cortiana & Rigotto, 2019).

The robotics-based intervention designed for the current study follows the aforementioned pattern. It is constructivist (Ștefan, 2017). It is a "user-oriented" idea that solves a practical, classroom-based problem (Talja et al., 2005). The problem identified here is the lack of student empathy in English III students at Sleepy Hollow High School. The challenges featured target empathy as it corresponds to student understanding of American Romanticism and the works of Washington Irving. Connections will be made and new knowledge will be assembled through an experiential activity that introduces robotics as a vehicle for demonstrating proficiency (Talja et al., 2005). This malleable, nonlinear process will make sense of both the deficits in reading comprehension and empathy, as students work together to affect understanding of three provided short stories: *The Devil and Tom Walker, The Legend of Sleepy Hollow* and *Rip Van Winkle*.

Robotics-based Interventions in Education

Robotics-based interventions have been used in public school, from kindergarten through twelfth grade (Zhong & Xia, 2018). They are most commonly associated with the domains of STEM (science, technology, engineering and math), although they are increasing thought to be appropriate in all disciplines (Di Lieto et al., 2017). The use of robotics has been proven to motivate students, empower learning and foster creativity across the board, at all levels of instruction (Castro et al., 2018; Di Lieto et al., 2017; Zhong & Xia, 2018). They are considered flexible and easily adapted to incalculable circumstances, ranging from art to mathematics and coding (Zhong & Xia, 2018). Robotics interventions can impact problem-solving and metacognition and can underscore the importance of an active manipulation of cognitive artifacts (Castro et al., 2018; Di Lieto et al., 2017).

There is also abundant research to suggest that robotics can successfully be used to impact empathy for those with autism spectrum disorders. Educational, assistive robots train and underscore "soft skills" for those on the autism spectrum (Scassellati et al., 2018). They instruct learners on the verbal and nonverbal cues for empathetic response, as well as what empathetic responses are appropriate in various scenarios. This mimicry of human movement and reaction stimulates behavioral shifts (Laurie et al., 2018). These shifts, then, bely an impact.

One study conducted in Italy, published in 2019, indicated that robotics can be effectively implemented within the literature classroom to increase student understanding of complex text (Cortiana & Rigotto, 2019). This study, written by Paola Cortiana and Chiara Rigotto, measured the proficiency of third grade students in relation to a written

prompt administered before and after an intervention involving the use of classroom robots. The results indicate that scores improved, and students formed "real" relationships with the robots which activated students on an emotional and cognitive level. In this way, robots and robotics-based initiatives "can foster a personal encounter with the text" (Cortiana & Rigotto, 2019). The study also underscored the importance and inherent value that arose from "integrating technology tools that belong in the daily lives of digital natives" (Cortiana & Rigotto, 2019).

The robotics-based intervention designed for the current study takes all of this into account. It will be implemented in a grade 11, or junior-level classroom. It will be paired with anchor texts by Washington Irving and backed by appropriate literature instruction regarding American Romanticism. Also, it will require students demonstrate understanding of the emotional states of characters by mimicking said emotional states with the robots, themselves.

Components of effective robotics-based initiatives.

There are incalculable benefits to implementing robotics in multidisciplinary classrooms. They are a proactive means of manipulated instruction as well as usable for students in all age groups (Robbins & Smith, 2016). Additionally, they provide students with 21st century skills that directly correlate to future jobs (Kim et al., 2019). All effective, stimulating robotics initiatives share three key components: they encourage the development of critical problem-solving skills, they require collaboration, and they inspire meaningful engagement with the material (Chevalier et al., 2020; Kim et al., 2019; Robbins & Smith, 2016).

The construction, programming and use of robotics forces students to move away from the structured-response background of traditional assessments in the classroom. Robotics experiences require iterative solutions in what is commonly referred to as the "trial and error loop" (Chevalier et al., 2020). In essence, there is not one prescribed solution; there are many potential solutions. The open-ended nature of this construct fosters the growth and development of critical problem-solving strategies since many possible paths to completion are presented and attempted.

Connected to this is the idea that robotics initiatives should be collaborative. The sharing of knowledge and the proposal of different solutions becomes a meaningful back-and-forth between peers that heightens the learning process (Chevalier et al., 2020; Robbins & Smith, 2016). This social-constructivist backing also lend itself to deeper engagement with the material and the process (Robbins & Smith, 2016). Deeper engagement, subsequently, helps instructors reach full efficacy as off-task behavior is diminished among students aiding in faster transfer and synthesis of information (Chevalier et al., 2020; Kim et al., 2019).

The intervention designed for this study addresses each component of effective robotics-based initiatives. The four challenges issued are open-ended; therefore, the potential exists for multiple paths to demonstrate proficiency and understanding. Students will be grouped into teams in order to complete them, encouraging collaboration. Additionally, allowing for multiple manners of assessment and participation should increase prolonged engagement with the text and the unit.

Embodied cognition.

The study of embodied cognition revolves around the idea that neurons in the brain react when the body completes a manual task, but also when the body notes the manual task being completed by another (di Pellegrino et al., 1992). In essence, our cognitive processes can be "grounded" in motion or movement (di Pellegrino et al., 1992; Dijkstra et al., 2014). Taking this one step beyond, maneuvering the body can then arguably result in cognitive shifts (Iani, 2021). This new development of knowledge is wholly reliant upon physical manipulation (Odendahl, 2021).

Theories of "body-bound experiences" rely heavily on the neural functions of observation, manipulation and corresponding emotion (Macrine & Fugate, 2021; Odendahl, 2021). Human reasoning is tied to the human body and the environment in which that body resides (Dijkstra et al., 2014; Iani, 2021; Macrine & Fugate, 2021). There is a reciprocal, contingent transaction that occurs when one's mind, one's body, and one's surroundings work together (van der Schaaf et al., 2018). This "dynamic system" can result in lasting connections with provided information, even of the abstract variety (Dijkstra et al., 2014; van der Schaaf et al., 2018).

The intervention designed for this study includes foundations of embodied cognition as a method in which to impact student empathy levels and reading comprehension. The robotics featured are manipulatives that require physical engagement and prolonged movement during the instructional process. This sensory-motor activity promotes heightened understanding of the nonconcrete concepts covered by rooting them an external process (Dijkstra et al., 2014).

Challenges in Implementing Robotics-based Interventions

There are challenges to implementing a robotics-based intervention aimed at impacting empathetic awareness in a secondary literature classroom. Overwhelmingly, there is a lack of clear and defined research. Robots are also expensive to procure and difficult to manipulate without an outside influence (Zhong & Xia, 2018). Access to available resources may be stymied due to budget constraints and/or location (Cortiana & Rigotto, 2019). The use of individual classes causes a small sample size that does not encourage transfer to a larger audience (Cortiana & Rigotto, 2019; Zhong & Xia, 2018). Additionally, there is an ethical consideration, as student use of the robots must be closely monitored.

Measures to combat the challenges to robotics-based interventions have been considered during the design process for the current study. The existing research, scarce that is, has been analyzed in order to provide structure and guidance. The robots have been procured by the researcher using personal funds. Manipulation training for the researcher was attained from a robotics engineer and all hands-on student activity will be conducted under the supervision of the trained researcher.

Chapter Summary

In summation, there is a definitive connection between empathy and reading comprehension, as supported by South Carolina College- and Career-Readiness Standards for English III. Empathy affects student abilities to connect and transact with complex text in order to generate new ideas, to interpret tone and purpose on the part of the author in both works of fiction and informational text, to understand character development and motivation in literary text, to make inferences, and to fully

communicate with the world on a larger platform. While it is instrumental in social and academic success, however, student empathy levels have dropped in recent years. Researchers support the idea that empathy can be impacted by outside forces. These forces include traditional methods of presentation and also cutting-edge technology-based initiatives. Of the technology-based initiatives, robotics is a promising method of encouraging students to consider and display an empathetic understanding of concepts beyond the immediate self. The scarcity of research in this specific context necessitates further action.

CHAPTER 3

METHOD

Introduction

The concept of empathy involves both the cognitive and the emotive processes that help us to collectively expand horizons in order to consider alternative points of view (Lasley, 2017). Empathy is a major facet of emotional intelligence, allowing us to figuratively place ourselves in the shoes of others (Franzese, 2017; Parker et al., 2017). As an emotional response, it is the leading factor influencing longitudinal success both personally and professionally (Suleman et al., 2019). As an analytical action, empathetic reasoning, or emotional deduction, is a powerful tool in the process of both teaching and learning (Franzese, 2017); yet empathy is on the swift decline in American students (Konrath et al., 2011). The purpose of this action research study was to evaluate the effect of a robotics-based initiative on empathy for students enrolled in English III at Sleepy Hollow High School. The research questions aligned with the study were as follows:

1. How does the use of robotics impact Sleepy Hollow High School English III students' levels of empathy?
2. What are student perceptions of the use of robotics in the English III classroom at Sleepy Hollow High School to impact empathy?

Research Design

This study featured an action research design (Mertler, 2017). Investigating and analyzing the impacts of technology on students' reported levels of empathy was the

primary goal of the outlined action research. Action research was the appropriate method with which to analyze this, as the core of the research practice focuses on practitioners identifying solutions to collective, real-world problems they are faced with in order to affect change (Mertler, 2017). Action research is, therefore, living research which seeks to improve given scenarios of learning (Antonio, 2018).

The essential difference between action research and traditional research is that action research is initiated and overseen by the professionals directly affected by the issue (Mertler, 2017). In this sense, the teachers and school personnel are invested in the outcome and the procedure after having ultimately determined an area of weakness (Waghid, 2018). The weaknesses or problems studied are personal to the participants and specific to the context, and the focus of the research is a change or an improvement (Mertler, 2017). Additionally, there is a decided emphasis on reexamination and revision (Zwick et al., 2018).

The goal and practicality of action research align perfectly with the objectives and vision of a study on student empathy in a high school literature classroom. It is an environmental issue specific to a context within which the researcher, as an instructor, plays an active role. The researcher then has a direct stake in the outcome of the study, and the study, itself, is interactive (Youngwanichsetha et al., 2019; Zhang et al., 2015). It allows the researcher to be hands-on in the process of implementing and reflecting on initiatives designed for the specific group influenced directly by the researcher. Furthermore, it requires a critical evaluation of what is done in the researcher's classroom (Mertler, 2017). This increases the relevancy of the study and proves a practical application of all concepts (Zwick et al., 2018).

The research design utilized in this study was a convergent mixed method action research design. This was most appropriate, given that it involves fusing both quantitative and qualitative data in order to develop a more detailed profile of the results (Campbell & Fiske, 1959). Crafting a study of empathy in a literature classroom required both an integral quantitative component and an equally integral qualitative component. The quantitative component came in the form of an empathy inventory and a Personal Reflection Survey. The qualitative component came in the form of field notes created by the researcher and one-on-one participant interviews. The sets of data were regarded as equally important (Creswell & Creswell, 2018). They were gathered and compiled simultaneously and then analyzed for similarities and differences in convergence (p. 218). In this way, validity and reliability were ensured.

Setting and Participants

Setting

The action research described was implemented at Sleepy Hollow High School, part of Tarry Town School District. Sleepy Hollow High School is a public, secondary institution comprised of 364 students in grades nine through 12 (Florence County School District Two, 2018a). The student to teacher ratio is 12:1, lower than the state average of 16:1 (Florence County School District Two, 2018a). Approximately 45% of the students enrolled are minority students; the largest portion of minority students identify as African American (South Carolina Department of Education, 2019c).

As compared to statewide averages, fewer students at Sleepy Hollow High School scored at the designated level of proficient on the End of Course Examination Program English I assessment in the 2019 academic year (South Carolina Department of

Education, 2019a). This assessment measures each student's ability to apply skills associated with the standards and indicators outlined for English and literature instruction in grade nine (Department of Education, 2018). Work is evaluated on a scale of zero to 100, with proficiency demonstrated at a score of 60+. Approximately 78.9% of students in grade nine in South Carolina scored in the 60+ range in 2019 while only 60.8% of grade nine students at Sleepy Hollow High School scoring in the 60+ range (South Carolina Department of Education, 2019a).

The action research intervention was implemented in a regular-education English III classroom during standard, ninety-minute block instruction. Typically, English III is the level of English language instruction that occurs immediately after students successfully pass English II. Standards and indicators for English III require that students master the domains of inquiry-based literacy, reading of the literary text, reading of the informational text, writing, and communication (Department of Education, 2018). The scope of English III instruction loosely follows the colonization and founding of the United States and traces the path of literature from the indigenous tribes through the Modern Period. English III is comprised of five units: Early American Writing, American Romanticism, Seminal U.S. Documents, Regionalism and Naturalism, and the Modern Period.

The described study required independent settings within Sleepy Hollow High School. All settings are shared spaces familiar to all students enrolled in English III. Permission from the building administrator was granted. Active robotics occurred during Phase II. This phase includes a review of the elements of American Romanticism, a review of Irving's short stories, a lesson on the basics of coding, an online escape room,

and four activities that involve manipulation of assigned robots. Room 107, the English and language arts classroom appointed to the researcher, served as the setting for the review of the elements of American Romanticism, the review of Irving's short storis, the lesson on the basics of coding, the online escape room, and one of the activities involving manipulation of assigned robots. Two additional activities involving manipulation of assigned robots occurred in the Sleepy Hollow High School gymnasium. The final activity occurred throughout the English and science hallway at Sleepy Hollow High School. The following section will describe these four settings in detail.

English and language arts classroom.

Room 107 is located on the English and science hallway at Sleepy Hollow High School. It is a converted earth science lab and features a bank of locked cabinets, in which the robotics equipment is stored. A large, dry erase board is affixed to the front wall, along with a Promethean flat panel interactive display board that is run through an HP 4050 laptop. There are fluorescent overhead lights, as well as LED lights that line the ceiling. The room is equipped with surround sound. There are four power receptacles in the room, along with four tower extension cords.

Student seating in the space is modular. There are 30 student desks and 28 student chairs. Desks can be arranged in a circular pattern for groups of five. Desks feature locking wheels, ideal for movement during large- or small-scale group activities. When desks are arranged in circular groups, ample space for movement and robotics manipulation is present.

Gymnasium.

Sleepy Hollow High School is a rural, public high school in Tarry Town County. The facility features a large, square-shaped gymnasium that serves a dual purpose as both an athletic facility and a performance space. Retractable bleachers flank both sides. Four basketball goals lower from the ceiling and a stage makes up the far wall, with locker rooms on either side. The maximum capacity for the space is 2500. Permission to use the space was granted by the Sleepy Hollow High School Athletic Director, as well as building administration.

English and science hallway.

All English and science courses at Sleepy Hollow High School are located along the same hall. Walkways are seven feet in diameter and devoid of student artwork or signage. The walls are beige. Classrooms on the right begin with 101, a lab used for working lunches and tutoring, followed by rooms 104, 106, and 107, which are English and language arts rooms. Rooms 110-112 are science classrooms.

On the left, classrooms begin with 102 and 103, which are Special Education hubs. In-school suspension is in room 105. Room 108 is a Special skills Lab. Room 109 is an Engineering Lab, followed by student restrooms, a maintenance closet and the cafeteria's kitchen. Security protocol indicates doors are to remain locked at all times, unless directed by building administration. For the purposes of the outlined challenge involved in the intervention, doors for participating teachers will remain open.

Participants

All students enrolled in English III with the researcher were invited to participate in the outlined study. English III is the third level of literature instruction and is

commonly assigned to grade eleven (Department of Education, 2018). Students in English III have successfully completed English II and are between the ages of 16 and 18, although current policy dictates students enrolled can be between the ages of 14 and 20. Typically, class sizes at Sleepy Hollow High School have between 11 and 30 students. They are evenly split by gender in core subject areas. The student body is 57% Caucasian and 43% minority, with the bulk of ethnic minority students identifying as African American.

Approximately 13 students were enrolled in English III with the researcher in the Fall of 2021. Eight of the 13 students were female, comprising 62% of the participant group. Five of the 13 students were male, comprising 38% of the participant group. Six of the 13 students identified as Caucasian, comprising 46% of the participant group. Four of the 13 students identified as African American, comprising 31% of the participant group. Three of the 13 students identified as multi-racial, comprising 23% of the participant group.

Tarry Town School District students in grades five through 12 have access to individually assigned HP Revolve 810 laptops and/or Google Chromebooks (Florence County School District Two, 2018b). Additionally, free, high-speed wireless internet access is provided in all classrooms across both campuses and on buses used for athletic and daily travel. All classes are equipped with a smart panel, touch display boards. Personal wireless devices are also available in the media center to provide easy access for students who reside in more remote areas.

Intervention

Robots are a statistically proven method to engage students and promote soft skills and emotional growth (Laurie et al., 2018; Purtill, 2019; Rosenthal-von der Putten et al., 2012). The hands-on nature of the modality pairs well with subject material in all disciplines (Jung & Won, 2018). The intervention featured active robotics play in Phase II of the study's five-phase deign. Here students worked with robot manipulatives to accomplish tasks in groups, honing critical thinking, collaborating and becoming engaged with material on a deeper level (de Jong et al., 2019; Robbins & Smith, 2016). Below, a description of the intervention is presented. Connections to existing research are made. The three components of effective robotics initiatives are outlined. The elements of the intervention are described in detail, implementation is defined and a timeline for Phase II is provided.

Description of the Intervention

The study designed contained five phases. Phase I involved the recruitment of participants, an overview of the process, and the Interpersonal Reactivity Index pre-assessment. Phase II involved active robotics play. Phase III involved the Interpersonal Reactivity Index post-assessment, the completion of a Personal Reflection Survey, and one-on-one interviews with the researcher. Phase IV involved data analysis. Phase V involves the sharing and communication of findings.

The predominance of participant interaction with robotics technology occurred in Phase II of the intervention. This phase lasted approximately two and a half weeks, or thirteen consecutive, ninety-minute class periods. It was paired with Unit Two: American Romanticism. In Phase II, participants used robots to accomplish challenges rooted in the

six outlined elements of American Romanticism, and the three short stories associated with American author, Washington Irving. Students analyzed provided notes and the texts, synthesized information related to coding and the control of the robots, and applied both skillsets to effectively navigate presented challenges.

The intervention was a key component of Unit Two: American Romanticism. This unit highlights the first major literary movement in American fiction, along with the contributions of three major writers: Washington Irving, Nathaniel Hawthorne and Edgar Allen Poe. The robotic-based initiative aligned with a presentation detailing six elements of American Romanticism and three short stories synonymous with Washington Irving: *The Devil and Tom Walker, The Legend of Sleepy Hollow* and *Rip Van Winkle*.

Connections to Existing Research

Interventions featuring robotics-based approaches are prevalent in a variety of settings within the sphere of K-12 instruction (Zhong & Xia, 2018). They have proven equally effective across disciplines and grade bands. The use of robotics is heavily featured in relation to the domains of science, technology, engineering and math (Di Lieto et al., 2017). Additionally, interactive or socially assistive robots can be found in the arena of special services, serving as cognitive influencers for students on the autism spectrum (Marti & Stienstra, 2013). While limited, existing research also indicates that piloting robotics in a literature classroom "can foster a personal encounter with the text" (Cortiana & Rigotto, 2019).

Robotics were an appropriate medium for the intervention described herein as they increase student engagement and stimulate deeper cognitive processes in adolescent learners (Glaskin, 2012; Rosenthal-von der Putten et al., 2012). They also fall within the

sphere of manipulatives and kinesthetic experiences often considered manifestations of embodied cognition (Iani, 2021; Odendahl, 2021). In this way, the use of robots as a "grounded" physical experience can ground abstract concepts in motion (di Pellegrino et al., 1992; Dijkstra et al., 2014). This theory of factual synthesis accepts that the "body plays a significant causal or constitutive role in cognitive processing" (Macrine & Fugate, 2021).

Three Components of Effective Robotics Initiatives

Effective robotics implementation should contain three components (Chevalier et al., 2020; Di Lieto et al., 2017; Kim et al., 2019; Robbins & Smith, 2016). Firstly, students should cultivate and practice critical problem-solving skills (Chevalier et al., 2020). Secondly, students should work in effective collaboration with peers (Robbins & Smith, 2016). Finally, students should exhibit enhanced or continued engagement with presented material (Kim et al., 2019; Robbins & Smith, 2016).

The intervention plan for the outlined research study addressed all three behaviors of effective robotics implementation. These components are described in Table 3.1.

Table 3.1 Components of Effective Robotics Interventions

Behavioral Components of Effective Robotics Implementation	Description	Components within the Proposed Intervention
Students should cultivate and practice critical problem-solving skills.	Through an iterative design process, students are encouraged to develop real-world, personalized solutions to presented, open-ended challenges (Chevalier et al., 2020; Robbins & Smith, 2016). Subsequently, this results in a "trial and error	Students will be tasked with completing a series of issued challenges with many possible paths to completion. This open-ended design encourages students to think outside the box and make numerous attempts in the face of adversity of failure.

	loop" in which students pioneer various strategies to accomplish goals (Chevalier et al., 2020).	Additionally, the challenges require both an understanding of the covered literary material and an understanding of robotics operation and coding, encouraging critical thinking and problem analysis.
Students should work in effective collaboration with peers.	Meaningful interaction with peers encourages the transfer of "ideas, knowledge and experience" for the benefit of all (Robbins & Smith, 2016). This social climate enhances the learning process, increases transfer and helps students hone 21st century soft skills (Kim et al., 2019; Robbins & Smith, 2016; Voulgari et al., 2014).	As both synthesis of textual elements and an understanding of robotics coding and operation are required for successful challenge completion, students must work together to identify personal strengths and weaknesses in order to design beneficial solutions.
Students should exhibit enhanced or continued engagement with presented material.	Tactile modalities like robotics create an environment of faster engagement and increased engagement in tasks for longer periods of time (Chevalier et al., 2020).	Students will be provided manual robotics equipment in order to stimulate interest and engage all levels of learners with tactile challenges.

Elements of the Intervention

The intervention began with an interactive review of the six elements of American Romanticism covered in connection with Washington Irving: conflict of spirit and body, good versus evil, exotic settings, faith versus doubt, imagery and native history. Students reviewed information related to the three short stories highlighted in the subsection focusing on America's first literary movement: *The Devil and Tom Walker, The Legend of Sleepy Hollow* and *Rip Van Winkle*. These reviews were conducted using interactive Quizizz software, which allowed students to select the correct response for multiple choice questions in real-time. Additionally, students viewed a series of brief animated

shorts emphasizing the central elements of plot within the short stories. These included *The Devil and Homer Simpson* (The Simpsons: Treehouse of Horror IV, 1993), *The Adventures of Ichabod and Mr. Toad* (Disney, 1949), and *The Rip Van Winkle Caper* (The Twilight Zone, 1961).

After reviewing the course material associated with the intervention, students took part in a "crash" session on robotic coding and manipulation. In this training, students learned everything needed to appropriately control the issued robotics. This began with block-coding practice using Code.org and Code Monkey. It then transitioned to text coding. Students synthesized the rules for acceptable behavior during the intervention and displayed understanding of them in an online Kahoot game.

The next step was for students to compete individually in a digital Escape Room requiring them to display a deeper understanding of American Romanticism. This understanding involved identifying key aspects, the historical timeframe and authors of note. The first four students to finish became Team Captains for the robotics challenges. Team sorting occurred. Team members then divvyed up team responsibilities. In addition to the Team Captain, each team had a Programmer, Researchers, and a Document Manager. The Team Captain oversaw the process, as a whole. The Programmer was primarily responsible for robotic manipulation. The Researchers identified correct responses to provided riddles and clues. The Document Manager compiled disseminated handouts and written directions and tracked team progress.

All of the aforementioned activities occurred in Room 107 at Sleepy Hollow High School.

Robots.

The manipulatives used in the intervention were Wonder Workshop Cue robots. These machines are approved for all students over the age of 11. They incorporate block coding, text-based coding, and customizable avatars using free software. They are moderately-priced and the software required is accessible on the iOS and Android platforms, as well as through the HP Revolve and Google Chromebook laptops supplied to all students in Tarry Town School District. There were four Cue robots available for use during the intervention. Attachments for the robots, allowing them to manipulate and lift objects, were also available. The Cue robots are featured in Figure 3.1, alongside Wonder Workshop *Go* software displayed on Apple iPad Pro.

Figure 3.1
Wonder Workshop Cue and Software

Students were given explicit instruction regarding manipulation of the robots using two software programs developed by Wonder Workshop. The first, Wonder Workshop *Go*, allowed students to use individual cell phones to act as controllers for basic movement. This movement was demonstrated in the starter challenge, challenge

two and challenge three. The second software platform, Wonder Workshop *Blockly*, allowed students to design and execute intricate, block-style codes to respond to riddles and/or questions regarding the emotional states of characters in-text. This movement was demonstrated in challenge one and challenge two. A depiction of the block-style code created in *Blockly* is presented in Figure 3.2.

Figure 3.2
Block-Style Codes with Blockly Software

Activities.

Starter Challenge. The first activity in the intervention was referred to as the Starter Challenge, or "Old Scratch's Swamp". This is a reference to Washington Irving's *The Devil and Tom Walker*, which served as the impetus for the activity. The Starter Challenge occurred inside the Sleepy Hollow High School Gym. All physical materials used to create the obstacle courses met the requirements laid out by the Sleepy Hollow High School Athletic Director in that they were lightweight and would not damage the gym flooring. Plastic cups were utilized as a building medium.

For this activity, student teams used the robots to navigate through three-dimensional obstacle courses using clues from the text. Student teams were given detailed instructions. Students were be issued paper copies of the short story. The purpose of this activity was to introduce students to effective robotics manipulation. All handouts for this activity can be found in Appendix B. A depiction of the obstacle course setup is featured in Figure 3.3.

Figure 3.3
Starter Challenge Obstacle Demonstration

Challenge One. The second activity in the intervention was referred to as Challenge One, or "A Tart Temper". This is a reference to Washington Irving's *Rip Van Winkle*, which served as the impetus for the activity. Challenge One occurred in Room 107.

For this activity, student teams used the robots to successfully provide correct answers to riddles created by the researcher. These riddles were based on textual elements from the short stories. Providing the answers could occur through any manipulated means – i.e. participants could mimic the emotional state of the character with the robots, write out the correct answer using the robots or record verbal dictation

for the robots to speak to the instructor. The purpose of this activity was to foster critical thinking and collaboration, and to strengthen emotional awareness through the use of open-ended riddles. All handouts for this activity can be found in Appendix B.

Challenge Two. The third activity in the intervention was referred to as Challenge Two, or "Captain Kidd's Treasure". This is a reference to Washington Irving's *The Devil and Tom Walker,* which served as the impetus for the activity. Challenge Two occurred on the English and science hallway.

For this activity, student teams were provided a map and asked to navigate the hall with the robot to provide quick answers to posed inquiries by staff volunteers. The inquiries focused on textual elements in the short stories covered in class, as well as elements of American Romanticism. Like the riddles featured in the earlier challenge, these inquiries were open-ended and volunteers accepted any display of understanding from the robots. The purpose of this activity was to hone student control of the robotic manipulatives, foster critical thinking and collaboration and strengthen emotional awareness through the use of open-ended riddles. Descriptions of the questions presented by volunteers can be found in Appendix B.

Challenge Three. The fourth activity in the intervention was referred to as Challenge Three, or "Sleepy Hollow". This is a reference to Washington Irving's *The Legend of Sleepy Hollow*, which served as the impetus for the activity. Challenge Three will occur inside the Sleepy Hollow High School Gym. All physical materials used to create the glow-in-the-dark obstacle course met the requirements laid out by the Sleepy Hollow High School Athletic Director in that they were lightweight and would not

damage or stain the gym flooring. Plastic cups were utilized as a building medium, along with glow-in-the-dark bracelets and tennis balls.

For this activity, student teams moved robots through a three-dimensional obstacle course while facing adversity in the form of the Headless Horseman and Old Scratch. This activity required robots to move and react quickly to interruption in an ever-changing, glow-in-the-dark landscape. The purpose of the challenge was to thoroughly immerse students in the difficulty the early American settlers would have faced when colonizing the depths of inhospitable wilderness, which influenced the direction of early American fiction. All handouts for this activity can be found in Appendix B. A depiction of the obstacle course setup is featured in Figure 3.4.

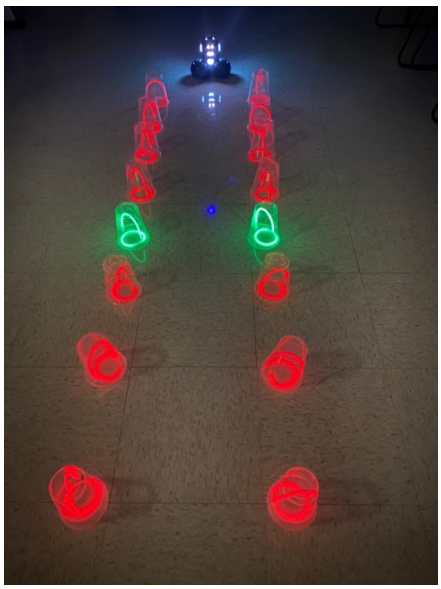

Figure 3.4
Challenge Three Obstacle Demonstration

Intervention Implementation

The intervention took two and a half weeks, or thirteen consecutive, ninety-minute class periods, to conduct. Table 3.2 illustrates the timeline by aligning components of the intervention, required time, and key activities.

Table 3.2 Phase II Timeline

Intervention Component	Length	Activities
Review of six elements of American Romanticism Review of Washington Irving Review of three short stories	2 days	• Interactive review games • Animated presentation
Basics of Coding Basics of Robotics Control	2 days	• Code.org / Code Monkey practice • Rules and Kahoot about appropriate behavior
Online Escape Room	1 day	• Whole group competition • Winners become team captains • Assignment of teams
Starter Challenge: *Old Scratch's Swamp*	1 day	• Obstacle course • Gym
Challenge One: *A Tart Temper*	2 days	• Riddles • English classroom
Challenge Two: *Captain Kidd's Treasure*	2 days	• Door-to-door with maps • English and science hallway
Challenge Three: *Sleepy Hollow*	3 days	• Obstacle course • Glow-in-the-dark • Gym

On days one and two, a review occurred of information covered in previous classes. This was conducted in Room 107 at Sleepy Hollow High School. This was conducted using hand-held mobile devices with access to the internet and a Promethean

smart panel display board. This was an integral step in the intervention design, in order to determine genuine synthesis of material related to American Romanticism, Washington Irving, and the three short stories has taken place.

On days three and four, students covered the fundamentals of coding and robotic control. This was conducted in Room 107 at Sleepy Hollow High School. This was conducted using district-issued HP Revolve and/or Google Chromebook laptops and free online software, as well as a Promethean smart panel display board. This step was significant in order to eradicate the lack of coding skills or robotics experience as a potential affecter of the study's findings.

On day five, students individually competed to quickly demonstrate proficiency in relation to all concepts covered on days one through four. This was conducted in Room 107 at Sleepy Hollow High School. This was conducted using district-issued HP Revolve and/or Google Chromebook laptops and free online software, as well as a Promethean smart panel display board. The top three scorers became Team Captains. The assignment of teams took place. The roles of Programmer, Researchers and Document Manager were decided by the students, themselves.

Day six involved active robotics play in a Starter Challenge. It took place in the Sleepy Hollow High School gymnasium. Students were issued one robot and one obstacle course. Completion of the challenge occurred when students successfully navigated the robot from an inception point to an end point using directions provided. All materials associated with the Starter Challenge can be found in Appendix B.

Days seven and eight involved active robotics play in Challenge One. It took place Room 107 at Sleepy Hollow High School. Students were reissued robots and issued

a sheet of 20 riddles of clues based on the text of the three short stories covered in class, as well as an attachment kit that gives each robot the power to lift, write or draw. To achieve completion, students used the robots to convey correct responses to each clue. Correct responses were accepted as mimicry or pantomime of emotional states, robot-written answers or programmed verbal responses. All materials associated with Challenge One can be found in Appendix B.

Days nine and ten involved active robotics play in Challenge Two. It took place in and around the English and science hallway at Sleepy Hollow High School. Students were reissued robots and attachment kits and issued a map. Students navigated the robots according to the directions on the map, taking the robots door-to-door and using solely the robots to communicate with staff volunteers. They were given questions pertaining to subject material and required to use the robot to convey an appropriate response, similar to how robots were used in Challenge One. The physical movement of the robots had to match the tone and mood of the answer (i.e. for questions related to the death of Tom Walker, the robot should not laugh or giggle). All materials associated with Challenge Two can be found in Appendix B.

Days eleven, twelve and thirteen involve active robotics play in Challenge Three. It took place in the Sleepy Hollow High School gymnasium. Students were reissued robots and attachment kits. Students then attempted to navigate the obstacle course one group at a time. The obstacle course featured elements from Washington Irving's work. Students were tasked with moving from the entrance to the exit while avoiding interference from unpredictable, outside influences. All materials associated with Challenge Three can be found in Appendix B.

Data Collection

This convergent mixed methods action research study was designed to generate both quantitative and qualitative data. Quantitative data was collected in the form of Interpersonal Reactivity Index surveys and Likert-style Personal Reflection Surveys. Qualitative data was collected in the form of researcher field notes and one-on-one interviews. Alignment of the data collection sources to research questions is presented below in Table 3.3. A thorough description of all data collection sources is also provided. The Internal Review Board for the University of South Carolina granted approval for all data collection on August 31, 2021. All supporting documentation can be found in Appendix C.

Table 3.3 Alignment of Research Questions to Data Collection Methods

Research Question	Data Collection Method
1. How does the use of robotics impact Sleepy Hollow High School English III students' levels of empathy?	Interpersonal Reactivity Index Researcher field notes Participant interviews
2. What are student perceptions of the use of robotics in the English III classroom at Sleepy Hollow High School to impact empathy?	Likert-style Personal Reflection Survey Participant interviews

Quantitative Data

Quantitative data was collected in two forms. To answer research question one, IRI surveys were presented as a Google Slide presentation to students before and after the robotics-based intervention. To answer research question two, Likert-style Personal Reflection Surveys were disseminated to students via a Google Form at the close of the

intervention. Personal Reflection Surveys were completed immediately following the post-intervention IRI in order to streamline the process.

Interpersonal Reactivity Index.

This study used the standard Interpersonal Reactivity Index in order to measure levels of empathy in English III students at Sleepy Hollow High School before and after an intervention involving robotics (Davis, 1980). Developed in 1980, the IRI is considered the most widely used measure to calculate and report levels of individual empathy (Ingoglia et al., 2016). The questionnaire is comprised of 28 items in four subscales consisting of seven items each (M. Davis, 1980). The subscales of *Fantasy* and *Perspective Taking* fall under the parameters of cognitive empathy while the subscales of *Empathic Concern* and *Personal Distress* fall under the parameters of affective empathy (Ingoglia et al., 2016). For each of the 28 items, responses are required that run from A (Does not describe me well) to E (Describes me very well) (Davis, 1980). Individual responses are assigned numerical point values. Table 3.4 displays each statement from the I.RI., as well as prescribed subscale and scoring guidelines. The IRI was piloted in an Introduction to Psychology course at Sleepy Hollow High School. One adjustment was necessary following the pilot test. Google Forms does not allow for reverse scoring when necessary, so students will answer on paper while projected IRI statements are displayed on a Promethean flat panel display board via Google Slides. Student participants indicated the A-E responses should be explained prior to dissemination of the IRI. A full copy of the IRI can be found in Appendix D.

Personal Reflection Survey.

Pioneered in 1932, Likert scale surveys have become the most well used measure of attitude-related agreement in the field of social research (Chyung et al., 2017; Li, 2013). These surveys are consistent and reliable, easily adapted for audiences from early childhood into adulthood (Li, 2013; Mellor & Moore, 2014). Each item on a Likert scale survey should contain an opinion, belief or attitude appropriately written for the survey's target audience (Li, 2013). These statements should be followed by five anchors, or points, the participant can select to demonstrate his/her own feeling in relation to the provided statement (Mellor & Moore, 2014).

The ordinal Likert scale disseminated to students in order to measure personal satisfaction in relation to the described intervention consisted of five statements. These statements were appropriately written to avoid negative language and complex vocabulary terms (Xu & Leung, 2018). Anchors for each statement were listed in descending order (Chyung et al., 2018). The personal reflection survey was developed by the researcher, patterned after consumer satisfaction surveys disseminated by Spectrum and Verizon Wireless. The surveys were provided to colleagues within the English and language arts department at Sleepy Hollow High School. Surveys were discussed and analyzed to generate student feedback during an Introduction to Psychology course on April 1, 2021. A full copy of the Personal Reflection Survey can be found in Appendix E.

Qualitative Data

Qualitative data was collected in two forms. To answer research question one, active robotics play was observed by the researcher and field notes taken were reviewed

in the data analysis phase. To answer research questions one and two, one-on-one interviews with study participants were conducted by the researcher.

Field notes.

The researcher observed all active robotics play. Active play occurred in Phase II of the intervention, on days six through 13. Extensive field notes were taken by hand as the researcher circulates during the intervention. At the close of each activity, the researcher reflected on each participant individually.

One-on-one interviews.

The researcher conducted one-on-one interviews with every participant at the close of the research study. Every participant was invited to take part in the interview process; however, participants were allowed to opt out of the activity. All 13 participants opted to participate. The researcher asked a series of seven open-ended questions related to the study's impact on empathetic reasoning abilities. Question alignment is displayed in Table 3.4.

The interviews were semi-structured. The participants were familiar with the interviewer, as both an instructor and mentor. Questions focused primarily on answering the prescribed research questions that guide the intervention and on issued course material. Interview questions can be found in Appendix F.

Table 3.4 Research Question to Interview Question Alignment

Research Question	Interview Question(s)
1. How does the use of robotics impact Sleepy Hollow High School English III students' levels of empathy?	• Can you tell me about a time you struggled with the activities? • Did you notice your classmates struggle? How did that make you feel?

2. What are student perceptions of the use of robotics in the English III classroom at Sleepy Hollow High School to impact empathy?	• Going through the exercise, do you feel differently about early American settlers now? • Tell me about your experience with the robots. • What are your impressions of the robotics activities? • What three words come to mind when you picture yourself completing the robotics activities?

Data Analysis

Data from the four sources was collected and analyzed using a convergent mixed methods approach. Both quantitative and qualitative data were synthesized and any convergence was identified and reported by the researcher. Each data analysis method is described below. Alignment of research questions to data collection and analysis methods is represented in Table 3.5.

Table 3.5 Research Question to Data Analysis Alignment

Research Question	Data Collection Method	Data Analysis Method
1. How does the use of robotics impact Sleepy Hollow High School English III students' levels of empathy?	Interpersonal Reactivity Index	Paired samples t-test Descriptive statistics
	Field notes	Inductive analysis
	Participant interviews	Inductive analysis
2. What are student perceptions of the use of robotics in the English III classroom at Sleepy Hollow High School to impact empathy?	Likert-type Personal Reflection Surveys	Descriptive analysis
	Participant interviews	Inductive analysis

Quantitative Data

The quantitative data collected in this study derives from two survey items. The first, the Interpersonal Reactivity Index, or IRI, measures empathy in four domains. The second, a Personal Reflection survey, measures student attitudes and beliefs about the robotics intervention as a means to impact empathy. Each survey required individual data analysis described below.

IRI.

The Interpersonal Reactivity Index is comprised of 28 statements. These statements correspond to four subscales, or domains, of empathy. Each domain relates to seven items. Students are required to select answer choices that range from A (Does not describe me well) to E (Describes me well). For 20 of the statements, statements are given numerical point values with A=0 and E=4. Eight of the statements are scored in reverse, with A=4 and E=0. Point values and scoring guidelines for each individual component of the IRI are displayed in Table 3.4.

Parametric testing was employed to analyze and display quantitative data derived from the pre- and post-intervention IRI assessments. This testing occurred in the form of paired T-Tests using JASP software (D. T. Campbell & Fiske, 1959; M. Campbell & Swinscow, 2009). Parametric testing was employed as the assumption can be made, despite the limited sample size, that the distribution of the participant population is 'normal' and indicative of the broader population at Sleepy Hollow High School (M. Campbell & Swinscow, 2009; Rosner, 2000). Additionally, the interpretation of the nonparametric equivalent to the paired T-test, the Wilcoxon signed-rank test, can be "more difficult" to interpret (A. Campbell, 2011; Rosner, 2000).

The paired samples t-tests measured the overall shift in scores among the participant population, as a whole. The tests also measured shifts by each of the four subscales of empathy, shifts by individual question, and shifts by student. In this way, a more accurate depiction of results could be generated (Winch & More, 1956).

Personal Reflection Survey.

At the close of the intervention, students were issued Personal Reflection surveys that tracked student beliefs and attitudes in relation to the intervention's efficacy at creating an impact on personal empathy levels. This Likert-type survey included five statements that students must agree or disagree with, based on a numerical ranking system identical to that of the Interpersonal Reactivity Index. A response of A would indicate "Strongly Disagree" while a response of E would indicate "Strongly Agree". These were scored as follows: A=4, B=3, C=2, D=1, and E=0. Higher numerical scores indicated less understanding of the intervention and the intervention process while lower numerical scores indicated higher understanding and personal valuation.

This section of quantitative data was analyzed using a descriptive statistical approach. Using this approach, the data was examined to determine distribution, central tendency and dispersion (Goos, 2015; Ho & Yu, 2015). Central tendency was identified and the dispersion of data illustrated the accepted range and standard deviation of the data set (Goos, 2015; Ho & Yu, 2015).

Qualitative Data

The qualitative data collected in this study derives from two sources. The first is field notes recorded by the researcher. The second is one-on-one interviews with the

intervention's willing participants. Each source required individual data analysis described below.

Field notes.

Observations were conducted by the researcher during and after the intervention. Field notes were be taken. During the intervention, the researcher synthesized student behavior while facilitating activities. Notes related to active robotics play were written. A constant comparative method of data analysis was employed. The frequency of behaviors, themes and patterns of behavior was determined using inductive reasoning (Kaluer & Phye, 2008). Relationships between themes were identified and described (D. Thomas, 2006). Frequency and variations were also noted. Rich, thick descriptions of activities were provided and transcribed.

Analysis of the notes followed four steps (Kaluer & Phye, 2008; D. Thomas, 2006). First, the researcher performed a close read of the tracked data (D. Thomas, 2006). Second, categories were created in order to classify similar behavior patterns (Picard et al., 2016; D. Thomas, 2006). Third, any convergence of categories was identified (D. Thomas, 2006). Finally, the process was conducted multiple times, revised, and refined (Kaluer & Phye, 2008; D. Thomas, 2006).

Interviews.

The researcher conducted one-on-one interviews with participants at the close of the intervention. These interviews were recorded. Recordings were transcribed and the constant comparative method of data analysis was again employed. Frequency and similarity of response were identified. These were documented, along with rich, thick descriptions of details and statements.

Inductive analysis occurred following the same pattern detailed for analyzing observations. The coding occurred in two cycles. The first cycle involved the In Vivo coding approach and the Emotion coding approach (Saldana, 2021; D. Thomas, 2006). The participants' own words or phrases were used to generate codes that are subsequently applied to the data set, as a whole (D. Thomas, 2006). Then, the participants' own words or phrases were sorted by emotional context and meaning (Saldana, 2021). Information was sorted using Delve online software and Microsoft Excel.

A transition phase occurred between the two cycles of coding. In this phase, codes generated in the first cycle were analyzed for alignment to the study's two provided research questions. The second cycle of coding involved the Pattern coding approach. The participants' own words and emotions were grouped in patterns by similarity (Saldana, 2021). These patterns were culled to become categories, which then became themes (Saldana, 2021; D. Thomas, 2006). This was done using Delve online software, Microsoft Excel and Microsoft Word.

Procedures and Timeline

The timeline of this research study involved five phases. Phase I consisted of recruitment and selection of participants, as well as communicating an overview of the study's expectations and purpose to students and parents. A pretest identifying individual levels of empathetic reasoning in students was also disseminated. Phase II involved the implementation of a robotics-based initiative and behavioral observations conducted by the researcher. Phase III included an empathetic reasoning posttest and focused interviews with willing participants. Phase IV centered around data analysis. Phase V will

include the sharing of findings with stakeholders. An approximate timeline for these five phases is outlined in Table 3.6.

Table 3.6 Intervention Timeline

Study Phase	Activities	Timeframe
Phase I	Recruitment of participants Overview of the study's purpose IRI pretest	10 class periods
Phase II	Robotics-based activities Behavioral observations	13 class periods
Phase III	IRI posttest Personal Reflection Survey Participant Interviews	5 class periods
Phase IV	Analysis of data	10 class periods
Phase V	Sharing of findings	3 weeks

Phase I

Phase I lasted approximately two weeks, or ten consecutive class periods. All students enrolled in English III at Sleepy Hollow High School were invited to participate in the outlined study. Information regarding the study and an invitation to participate were disseminated electronically and physically to students on day one of week one. All students elected to participate in the study.

On day five of week two, participants rated personal levels of empathetic awareness and reasoning using a version of the Interpersonal Reactivity Index modified for an adolescent audience. This version of the IRI was administered via Google Slides with student responses completed on paper, with the 28 statements comprising the IRI displayed on a Promethean smart panel display board.

Phase II

Phase II lasted two and a half weeks, or thirteen consecutive class periods. In this phase, students synthesized information related to the robotics equipment featured in the intervention and learned basic coding. They familiarized themselves with the robots and were sorted into teams. The intervention then involved using robots to navigate a series of challenges patterned after course material related to American Romanticism, Washington Irving, *The Devil and Tom* Walker, *The Legend of Sleepy Hollow* and *Rip Van Winkle.* Directions for successful completion of the intervention was provided to participants. Active play was observed.

Phase III

Phase III will last one week, or five consecutive class periods. Students reevaluated personal levels of empathetic reasoning by taking the IRI posttest. Students also rated the perceived efficacy of the intervention on a Likert-style personal reflection survey. The researcher conducted one-on-one focused interviews with each participant regarding personal feelings that emerged during the intervention process. All participants were invited to interview; no participants opted out of the process.

The interviews were conducted on days one through three of the study's final week, week six. The interviews lasted no more than ten minutes each and occurred during the participant's prescribed class period. Interviews were recorded and subsequently transcribed by the researcher.

Phase IV

Phase IV lasted two weeks, or ten consecutive class periods. Data was analyzed using qualitative and quantitative methods. Themes were identified. Significant results

were determined. The researcher conducted this phase, though all quantitative analysis was overseen by the dissertation chair.

Phase V

Phase V focuses on the dissemination of results to stakeholders and interested parties. This presentation will occur first to administrators of Sleepy Hollow High School and Tarry Town School District at the opening of the 2022-2023 academic year. Second, a presentation will be organized for interested teachers in Tarry Town School District as well as to the study's participants and guardians of participants during the fall semester of 2022. Finally, the researcher will deliver findings to the Tarry Town School District Board of Trustees at the September meeting.

Rigor and Trustworthiness

Rigor and trustworthiness of qualitative data collection are integral pieces of reporting accurate, believable results that readers can be confident in (Kelm et al., 2014). Without the certainty that researchers can trust what has been reported as fact, data collection loses all credibility in the field of social science. Many methods exist with which to do this. For the described research study, triangulation, member checking and the creation of an audit trail lend themselves to establishing clear, trustworthy findings.

First, triangulation was employed throughout the study. Using this method, data from both one-on-one interviews and behavioral observations was analyzed for convergence, in order to generate a reliable depiction of what occurred during the intervention. All documentation, including notes and transcriptions, was produced in order to substantiate findings. This is an effective strategy for helping researchers develop a concise understanding of whether the intervention was effective at impacting

study empathy (Youngwanichsetha et al., 2019). Rather than only focus on data from one collection source, the researcher will use two separate sources.

Member checking was also be utilized. After one-on-one interviews with willing participants, the researcher transcribed all data using Microsoft Word. The transcriptions were then checked by the individual participants and analyzed by the individual participants. This ensured that identified themes are universal and understood. It also reinforced that nuance of response is appropriately conveyed (Lasley, 2017; Youngwanichsetha et al., 2019).

Peer debriefing was also utilized in the study. At the close of each of the described challenges, the researcher sat down with members of the English department at Sleepy Hollow High School and discussed participant performance as well as limitations of the activities. Suggestions and feedback were taken into account.

Finally, an audit trail was implemented. This involves compiling all notes, documents, and surveys for submission with the study's findings (Lasley, 2017). By employing this technique, transparency is granted and margin for independent interpretation is eliminated. The researcher also recorded thoughts and personal reactions before and after each of the one-on-one interviews, and at every step of the research process.

Plan for Sharing and Communicating Findings

The purpose of this action research is to evaluate the effect of a robotics-based initiative on impacting empathetic reasoning and reading comprehension for students enrolled in English III at Sleepy Hollow High School. The findings generated will be

shared with stakeholders at varying levels of the research design and implementation process through four stages.

First, a formal presentation will be made to the building administration and faculty of Sleepy Hollow High School. This will occur at the opening of the 2022-2023 academic year. A formal report will be disseminated and possible suggestions regarding further inquiry will be discussed. Samples of student reflections will be provided and all student identifiers will be concealed to protect the privacy of participants.

Second, presentations will be made to student participants, parents, and within the Introduction to Psychology course at Sleepy Hollow High School, at the behest of the instructor. This will occur in the fall semester of the 2022-2023 academic year. A modified report will be disseminated with a more formal version available upon request. The study's findings will be highlighted and future ramifications will be discussed in an informal style.

Third, the formal presentation provided to building administrators will be refined and given a second time, for the benefit of the Superintendent of Tarry Town School District and the Tarry Town School District Board of Trustees. This will occur at the September 2022 board meeting. Highlights of findings will be outlined. Suggestions for reshaping English and literature instruction within Tarry Town School District will also be provided.

Finally, the ultimate goal of the researcher is to present the findings from the study on a larger scale in order to impact curricular direction. A proposal to present the findings was accepted by the Association for Educational Communications and Technology Conference. Additionally, the researcher plans to submit a proposal to the

South Carolina Conference for Teachers of English. This will provide valuable insight into meaningful ways that technology can be integrated in English and literature classrooms for the benefit of all students. So often, technology direction for ELA is geared toward showcasing presentation software. It is necessary, in order to foster creativity and collaboration for future generations, that more planning be introduced in this environment so that students from all backgrounds have the tools to think and write toward achievement.

CHAPTER 4

ANALYSIS AND FINDINGS

Introduction

The purpose of this action research was to evaluate the effect of a robotics-based initiative on empathy for students enrolled in English III at Sleepy Hollow High School. The findings from this study will shape curriculum as it relates to the integration of robotics technology in literature courses as a means to increase performance on standardized assessments. Furthermore, the findings will influence the direction of future studies of student empathy as it relates to academic achievement, in general. The data collection involved in this study was aligned to two research questions:

1. How does the use of robotics impact Sleepy Hollow High School students' levels of empathy?
2. What are student perceptions of the use of robotics in the English III classroom at Sleepy Hollow High School to impact empathy?

This chapter supplies evidence of the impact of a robotics intervention on student empathy levels gathered from participants during the data collection phase. There were 13 students enrolled in English III with the researcher; all 13 students agreed to participate in the study. The chapter is divided into sections illustrating data interpretation for each domain of the mixed methods research design. The quantitative results are described first. These results involve the analysis of students' responses to the pre/post-

intervention Interpersonal Reactivity Index and a Personal Reflection Survey. The qualitative results are described second. These results involve evidence from researcher field notes and individual participant interviews. The findings from each source will be integrated in the conclusion.

Quantitative Findings

This section details quantitative results from participant data collected via the Interpersonal Reactivity Index (IRI), both pre- and post-intervention, as well as data generated from the Personal Reflection Survey. The data outlined here include participants' overall scores on the IRI, as well as a breakdown for all four subscales. This is discussed first. A descriptive breakdown of participant scoring on the Personal Reflection Survey is discussed second. An integrated summary of both data sources is provided at the end.

Interpersonal Reactivity Index

The Interpersonal Reactivity Index was administered to participants enrolled in English III with the researcher before and after the robotics intervention. This instrument was developed by Mark Davis (M. Davis, 1980). In the field of Psychology, it is considered to be the "standard" measure of empathy for those aged 11 and older (Hawk et al., 2013). The IRI consists of 28 statements that correlate to the two primary domains of empathy – cognitive empathy and affective empathy (Cassels et al., 2010; M. Davis, 1980; Hawk et al., 2013). Each domain is represented by two subscales. Perspective Taking (PT) and Fantasy (FS) comprise the domain of cognitive empathy. Empathic Concern (EC) and Personal Distress (PD) comprise the domain of affective empathy.

For each of the 28 provided statements, participants indicate the accuracy of the description, or likeness to themselves. Nineteen of the statements demonstrate empathetic tendency (i.e. “I often have tender, concerned feelings for people less fortunate than me.”) (M. H. Davis, 1980). For these, participants use a 5-point Likert-type scale that begins with A (“Does not describe me well”) and runs through E (“Describes me very well”). Each response is given a numerical value with A equal to zero and E equal to four. Nine of the statements demonstrate a lack of empathetic tendency (i.e. “Other people’s misfortunes do not usually disturb me a great deal.”) (M. Davis, 1980). These items are scored in reverse, with A equal to 4 and E equal to 0. The Cronbach’s alpha levels for the IRI as it was administered in the aforementioned study are illustrated in Table 4.1.

Table 4.1 Cronbach’s alpha Reliability Testing

Subscale	Pre-Intervention *a*	Post-Intervention *a*
Overall	.857	.829
Fantasy	.845	.839
Personal Distress	.657	.716
Empathic Concern	.682	.621
Perspective Taking	.366	.402

The range for overall scores and for the subscale of Fantasy fall within the parameters of what are considered highly reliable for Likert-style questionnaires in scientific research (Baldner & McGinley, 2014; Taber, 2018). The subscales of Personal Distress and Empathic Concern yield alpha values that are on the low end of what is considered satisfactory (Taber, 2018). The subscale of Perspective Taking yielded a Cronbach’s alpha value that is not considered acceptable, but this subscale was kept in order to analyze the change in students’ perspective taking (Taber, 2018).

Descriptive Statistics.

First, the data were analyzed using descriptive statistics. The descriptive statistics indicate that student empathy scores on the Interpersonal Reactivity Index did increase from pre- (M= 58.77, SD= 16.73) to post- (M= 61.38, SD= 14.20) intervention. The overall scores for each participant, as well as scores for the four aforementioned subscales were analyzed. Scores for each subscale are illustrated in Table 4.2.

Table 4.2 Descriptive Statistics for Subscales

Subscale	Pre-Mean	Pre-SD	Post-Mean	Post-SD
Fantasy	16.85	7.49	18.15	6.69
Perspective Taking	13.92	3.71	14.08	4.01
Empathic Concern	16.54	4.50	16.77	3.98
Personal Distress	11.46	5.93	10.69	5.75

Descriptive statistics indicate that scores on three subscales increased; scores on one subscale decreased. The subscale of Fantasy increased from pre- (M= 16.85, SD= 7.49) to post- (M= 18.15, SD= 6.69) intervention. The subscale of Perspective Taking increased from pre- (M= 13.92, SD= 3.71) to post- (M= 14.08, SD= 4.01) intervention. The subscale of Empathic Concern increased from pre- (M= 16.54, SD= 4.50) to post- (M= 16.77, SD= 3.98) intervention. The subscale of Personal Distress decreased from pre- (M= 11.46, SD= 5.93) to post- (M= 10.69, SD= 5.75) intervention.

Shapiro-Wilk normality testing.

The normality of the data was determined using a Shapiro-Wilk test. A Shapiro-Wilk test using SPSS software was performed in order to ascertain whether the values in each data set were normally distributed (Liang et al., 2009). In this calculation, the differences between each of the sets was also identified. Resulting p values less than .05 indicate that the results are not part of data sets following normal distribution patterns.

Resulting *p* values over .05 indicate that the results are part of a set following normal distribution patterns.

The data set generated by the Interpersonal Reactivity Index implemented in the study yielded split results, as outlined in Table 4.3. The *p* values for overall scores (*p*= .037) and the subscales of Fantasy (*p*= .045) and Perspective Taking (*p*= .005) are not part of normally distributed data sets. The *p* values for the subscales of Empathic Concern (*p*= .261) and Personal Distress (*p*= .384) are part of normally distributed data sets.

Table 4.3 Shapiro-Wilk Tests of Normality

Subscale	Statistic	df	Sig.
Overall Scores	.858	13	.037
Fantasy	.865	13	.045
Perspective Taking	.787	13	.005
Empathic Concern	.921	13	.261
Personal Distress	.934	13	.384

These results dictate the next steps in the data analysis. Normally distributed data sets are subjected to parametric testing in the form of paired sample *t*-tests in SPSS software. Effect size was determined using Cohen's *d* (Peng & Chen, 2014). Data sets that do not follow the standards for normally distributed data are subjected to nonparametric testing in the shape of Wilcoxon signed-ranks tests. Effect size is determined by using Pearson's *r* (Salgado, 2018).

Paired sample *t*-test.

Using SPSS software, paired sample *t*-tests were run on the subscales of Empathic Concern and Personal Distress, comparing participant scores pre- and post-intervention (Rietveld & van Hout, 2017). These tests display that participants' scores increased

between the pre-intervention administration of the IRI and the post-intervention administration of the IRI. Participants scored higher on the subscale of Empathic Concern from the pre-intervention IRI (M= 16.54, SD= 4.50) to the post-intervention IRI (M= 16.77, SD= 3.98), t= .674, p > .001, Cohen's d= .187. Participants scored higher on the subscale of Personal Distress from the pre-intervention IRI (M= 11.46, SD= 5.93) to the post-intervention IRI (M= 12.31, SD= 5.39), t= .674, p > .001, Cohen's d= .491. The value calculated as Cohen's d indicates that the effect size is just below what is considered medium (Cohen, 1988).

As depicted in Table 4.4, the general increase in participant scores from pre- to post-intervention on the subscales of Empathic Concern and Personal Distress were not statistically significant. The values for p remain above the accepted threshold of .05. An analysis of the effect size substantiates this understanding. Cohen's d values from the subscale of Empathic Concern (d= .187) and the subscale of Personal Distress (d= .102) indicate the data remains within the parameters of what is considered a medium effect (Cohen, 1988).

Table 4.4 Paired samples t-test for Subscales: Empathic Concern and Personal Distress

Variable	Pre-Intervention		Post-Intervention		*t*	df	*p*	Cohen's *d*
	M	*SD*	*M*	*SD*				
Empathic Concern	16.54	4.5	16.77	3.98	0.674	12	0.513	0.187
Personal Distress	11.46	5.93	12.31	5.39	1.77	12	0.102	0.491

Wilcoxon signed-ranks tests.

Using SPSS software, Wilcoxon signed-ranks tests were run on the overall results, as well as the subscales of Fantasy and Perspective Taking. The Wilcoxon signed-ranks test is used to compare matching samples and is considered the equivalent to a paired samples *t*-test for data sets that do not follow accepted parameters for distribution (Zimmerman & Zumbo, 2010). An average participant score was calculated for pre- and post-intervention overall scores, as well as for the two identified subscales. These averages were then compared. The effect size was calculated using Pearson's *r*.

As depicted in Table 4.5, the change in participant scores from pre- to post-intervention on the subscale of Perspective Taking (Z= -.905, p= .366) was not statistically significant. The value of p remained above the accepted threshold of .05. However, the changes from pre- to post-intervention for the subscale of Fantasy (Z= -2.555, p= .011) and for participants' overall scores (Z= -2.273, p= .023) yielded p values less than the accepted threshold of .05 indicating the results were statistically significant. The effect size was then calculated using the formula for Pearson's *r*. For the subscale of Fantasy, r= .45. For participants' overall scores, r= .50. Both of these values fall within the range of medium effect.

Table 4.5 Wilcoxon Signed-Ranks test for Overall Results and Subscales: Perspective Taking and Fantasy

Variable	Pre-Intervention		Post-Intervention		*Z*	*p*	*r*
	M	*SD*	*M*	*SD*			

Overall Scores	58.77	16.734	61.38	14.198	-2.273[b]	0.023	0.5
Perspective Taking	13.92	3.707	14.08	4.01	-.905[b]	0.366	
Fantasy	16.85	7.493	18.15	6.694	-2.555[b]	0.011	0.45

[b]Based on positive ranks.

Personal Reflection Survey

The Personal Reflection Survey was developed by the researcher to gauge participant perception of the intervention's impact on empathy. It was administered to all 13 participants post-intervention. The survey is comprised of five statements. These statements require students to identify feelings related to personal levels of empathy post-intervention. For each of the statements, participants indicate agreement using a five-point Likert-style scale ranging from "Completely agree" to "Completely disagree". Each response is assigned a numerical value with "Completely agree" equal to four and "Completely disagree" equal to zero. The calculated Cronbach's alpha for the survey (a= .886) indicates that the survey is reliable.

Descriptive Statistics.

Descriptive statistics for the Personal Reflection Survey are presented in Table 4.6. Items one (M= 3.31, SD= .855), three (M= 3.23, SD= .599), and five (M= 3.15, SD= .555) had the highest average participant scores. Items four (M= 2.92, SD= .862) and two (M= 2.46, SD= .967) had the lowest participant scores.

Table 4.6 Personal Reflection Survey Descriptive Statistics (N = 13)

Item	*M*	*SD*
One	3.31	.855
Two	2.46	.967
Three	3.23	.599
Four	2.92	.862
Five	3.15	.555

Personal Reflection Survey Descriptive Statistics (N = 13)

In summary, the Interpersonal Reactivity Index and the Personal Reflection Survey were analyzed using accepted practices for quantitative inspection. Descriptive statistics were calculated for both using Microsoft Excel and SPSS software. A Shapiro-Wilk test was conducted to determine the normality of distribution within the data sets. Parametric testing, including a paired-sample *t*-test and the identification of Cohen's *d* was conducted using SPSS software for the subscales of Empathic Concern and Personal Distress. The determined *p* values indicated no significant chance occurred from pre-intervention administration of the IRI to post-intervention administration of the IRI. Nonparametric testing, including a Wilcoxon signed-ranks test, was conducted using SPSS software for the subscales of Perspective Taking and Fantasy, as well as on overall scores for all participants. The determined *p* value for the subscale of Perspective Taking indicated no significant change occurred from pre-intervention administration of the IRI

to post-intervention administration of the IRI. The identification of Pearson's *r* for each indicates the effect size as medium.

Qualitative Findings and Interpretations

This section details qualitative results from two sources. Researcher field notes were documented during the intervention. Independent interviews with all participants were conducted post-intervention. The data outlined here include detailed coding of interview data. Sources or qualitative data are discussed first. The analysis of data is discussed second. A presentation of findings is discussed third.

Data Sources

Field notes.

For all four of the intervention's robotics activities, field notes were collected in real time. The researcher employed a method of creating visual representations of data as participants completed issued challenges. In this way, insight into group dynamics and individual performance were captured for further annotation and inspection (Mahyar et al., 2012). This provides another layer of comprehension and interpretation in the data analysis phase through detailed narrations of the intervention.

The researcher also reflected on the behaviors and achievements of participants and participant groups at the close of each activity. These field notes are written as line items with numbers assigned to each participant. Revisions suggested for repeat activities are also provided.

Field notes were originally recorded using pen and paper. Microsoft Word documents were then created. Word documents were uploaded into Delve software for

inductive analysis. All field notes, including redacted PDF documents and Microsoft Word documents, can be found in Appendix G.

Participant interviews.

All 13 participants involved in the intervention were interviewed at the conclusion of the study. Each participant was asked six questions by the researcher in a semi-structured format. This allowed for addressing emergent issues in addition to asking preset questions (J. W. Creswell, 2014; DeJonckheere & Vaughn, 2019). Semi-structured interviews also allow the researcher deeper insight into the emotions and understanding of the participants about empathy and the robotics intervention (DeJonckheere & Vaughn, 2019).

The interviews occurred in the English and language arts classroom. Each interview was recorded and then transcribed by the researcher using Microsoft Word. Transcriptions were validated using member-checking. Each participant reviewed their own transcripts and confirmed the accuracy and interpretation of all responses. Word documents were uploaded into Delve software for inductive analysis.

Data Analysis

All field notes and transcripts were analyzed using inductive analysis (Saldana, 2021). First, the data sets were reviewed by the researcher multiple times. This served to familiarized the researcher with the data contained in each set. All Microsoft Word documents were imported into Delve coding software online. Two cycles of coding were performed on the data. Each cycle included multiple rounds of coding. The first cycle involved In Vivo coding methods and Emotion coding methods (Saldana, 2021). The second cycle involved Pattern coding methods (Saldana, 2021). A transition phase was

included between the two cycles. The total number of final codes from each source is depicted in Table 4.7.

Table 4.7 Final Codes

Data Sources	Final Open Code Applied
Field Notes	30
Interview Transcripts	172
Total of Sources	202

First cycle coding.

The first cycle of coding involved two rounds of coding the qualitative data within Delve software to identify commonalities among the responses (Saldana, 2021). Detailed field notes and interview transcripts were dissected. Representations of this are depicted in Figure 4.1 and 4.2. Both rounds of coding in the first cycle are described in detail below.

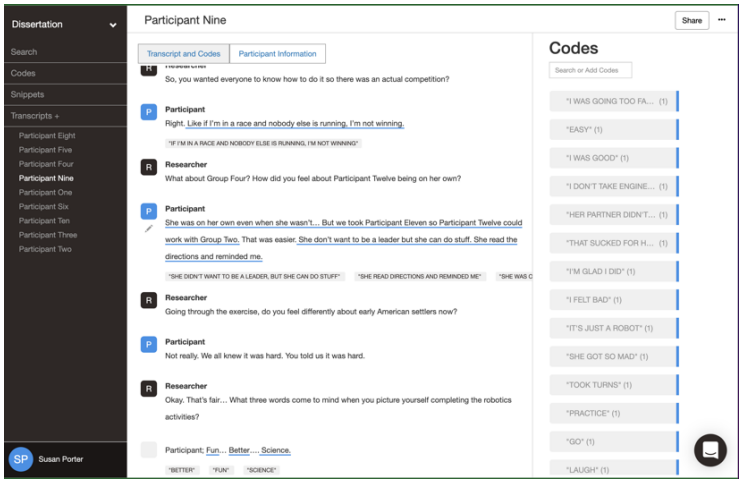

Figure 4.1
Open Coding in Delve software

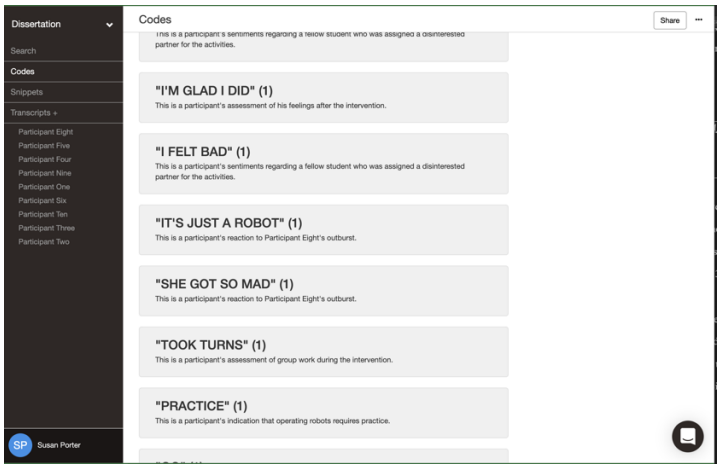

Figure 4.2
Codes in Delve Software

Round one. The first round of coding incorporated In Vivo coding methods. In Vivo coding was used to employ participants' own words and phrases related to their experiences as a way to depict personal feelings related to the intervention (Saldana, 2021). By employing the "direct language" of the participants, it concisely summarized all implied meaning volunteered while prompting the researcher to synthesize the information in order to develop lines of further inquiry with the data set (Maher et al., 2018; Saldana, 2021).

This round of coding produced 30 In Vivo codes related to the field notes and 172 In Vivo codes related to the transcripts. These codes were imported from Delve software to Microsoft Excel. Peer-debriefing occurred during a meeting between the researcher and the dissertation chair (J. Creswell & Creswell, 2018; Saldana, 2021).

Round two. The second round of coding incorporated Emotion coding methods. Emotion coding was used to capture the emotional states and responses of the participants during the intervention (Saldana, 2021). Emotion coding is most appropriate for capturing interpersonal and/or intrapersonal dynamics and experiences (Onwuegbuzie

et al., 2016). This allowed the researcher to touch on the feelings participants manifested during the intervention process.

This round of coding produced seven Emotion code related to the field notes and 22 Emotion codes related to the transcripts. These codes were imported from Delve software to Microsoft Excel. Peer-debriefing occurred during a meeting between the researcher and the dissertation chair (J. Creswell & Creswell, 2018; Saldana, 2021).

Transitional phase.

To progress from the first cycle of coding to the second cycle of coding, all codes within Microsoft Excel were consolidated into one spreadsheet. They were then analyzed for correlation to the study's two research questions in order to identify pertinence to the purpose of the study. Each response was then color-coded as potentially relevant to research question one or research question two. An example of this color-coding process is depicted in Figure 4.4, which responses highlighted in pink correlated to research question one and responses highlighted in blue correlated to research question two. This was done to streamline the analysis of codes in later stages.

	Code Name
2	"I WAS GOING TOO FAST"
3	"EASY"
4	"I WAS GOOD"
5	"I DON'T TAKE ENGINEERING CLASSES"
6	"HER PARTNER DIDN'T DO NOTHING."
7	"THAT SUCKED FOR HER"
8	"I'M GLAD I DID"
9	"I FELT BAD"
10	"IT'S JUST A ROBOT"
11	"SHE GOT SO MAD"
12	"TOOK TURNS"
13	"PRACTICE"

Figure 4.3
Transitional Phase Color-Coding of First Round Data

Second cycle coding.

The second cycle of coding involved pattern coding methods of the qualitative data within Microsoft Excel. This method of coding requires the researcher to group data by commonality of response (Saldana, 2021). These groupings first result in patterns, which are subsequently refined to form themes within the data set (Onwuegbuzie et al., 2016; Saldana, 2021). It is most appropriate for second coding cycles to generate broader, overarching meaning (Onwuegbuzie et al., 2016).

The 30 In Vivo codes generated in the first round of coding the field notes, along with the 172 In Vivo codes generated in the first round of coding interview transcripts, were filtered into patterns in a four-step process. First, data was analyzed in Microsoft Excel. Second, similar codes from transcripts were listed together on individual sheets of college-ruled notebook paper. Third, similar codes from field notes were added to the existing sheets of college-ruled notebook paper. Finally, titles for each pattern were generated. Figure 4.4 and Figure 4.5 depict the second step of the coding activity. Figure 4.6 and 4.7 depict the third step of the coding activity.

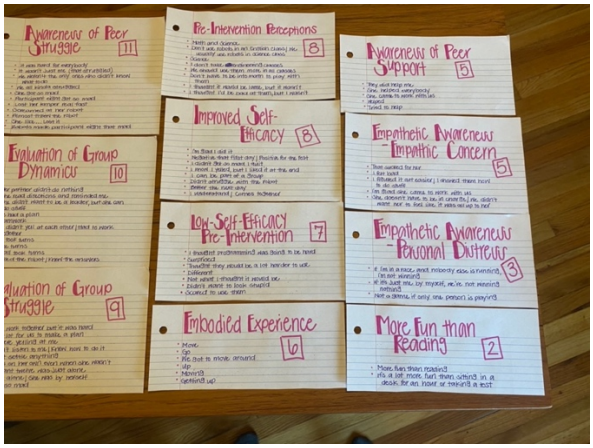

Figure 4.4
Pattern Coding Interview Transcripts – 1

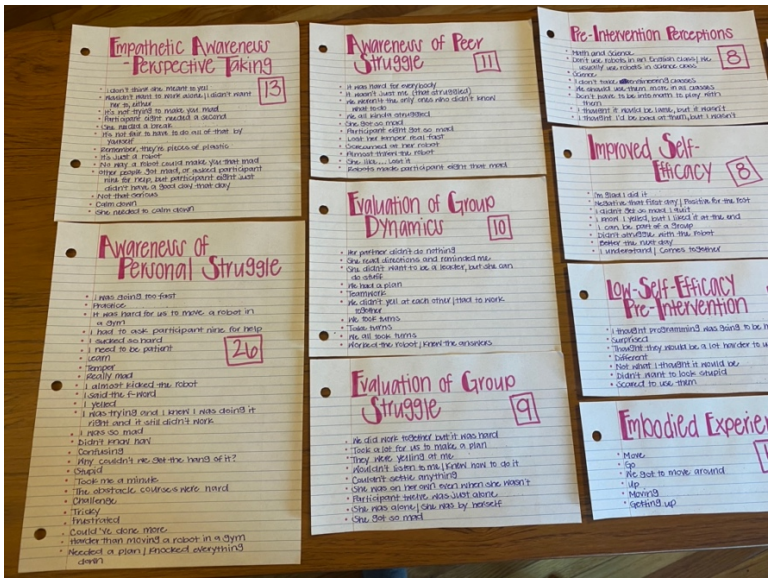

Figure 4.5
Pattern Coding Interview Transcripts - 2

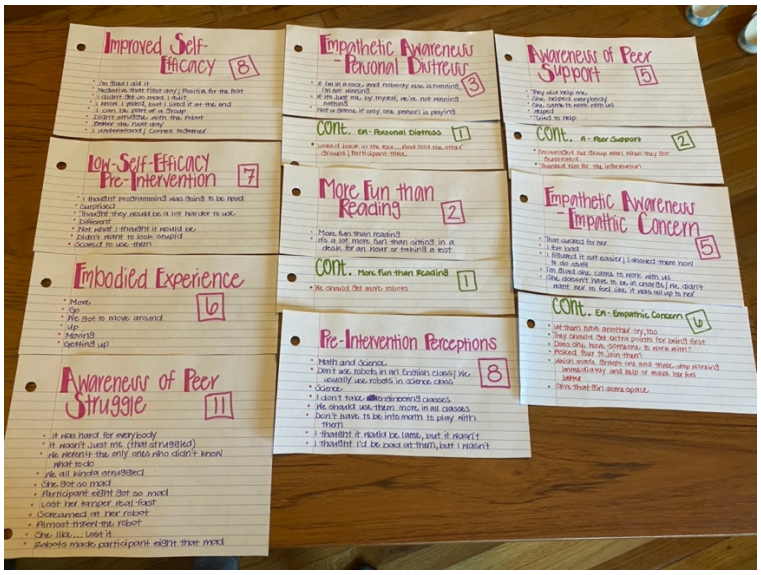

Figure 4.6
Pattern Coding Interview Transcripts with Field Notes – 1

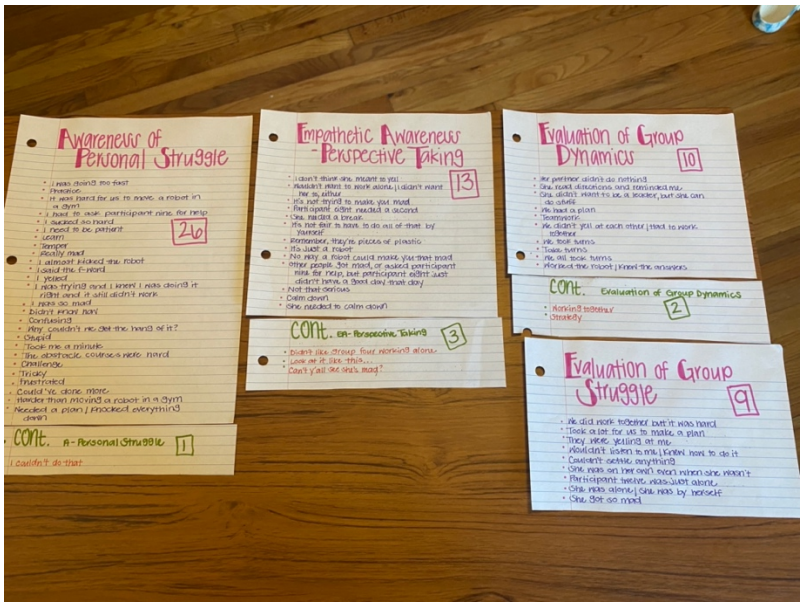

Figure 4.7
Pattern Coding Interview Transcripts with Field Notes - 2

All 202 generated In Vivo codes were inspected for convergence and similarity. As a result, 13 patterns were identified. Additionally, 23 codes were combined and 50 codes were eliminated.

Prior to identifying categories within the patterns, the researcher stepped away from code examination in order to approach it again reenergized (Saldana, 2021). Narrowing the field of focus from patterns to categories is both necessary and labor intensive (Onwuegbuzie et al., 2016; Saldana, 2021). Patterns were grouped together by similarity of response. The researcher then developed new titles for each. After analysis of the 13 created patterns, two were eliminated as not providing answer or insight into the study's associated research questions. Five categories were then identified. Figure 4.8, Figure 4.9 and Figure 4.10 depict this process.

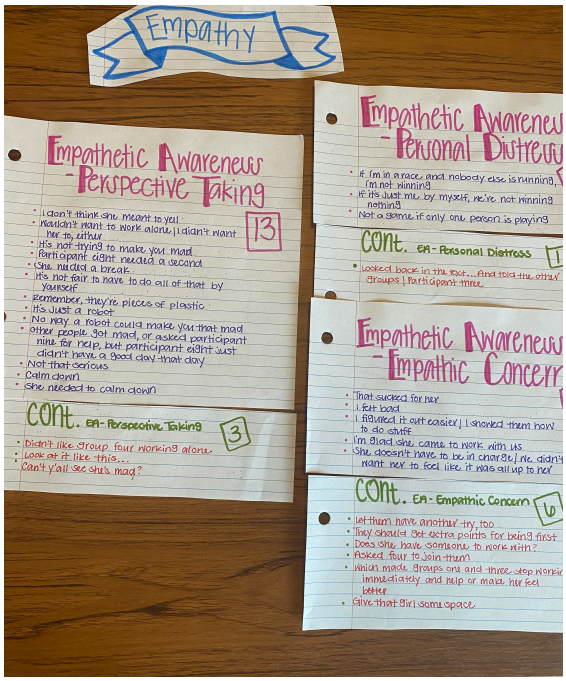

Figure 4.8
Patterns to Categories - 1

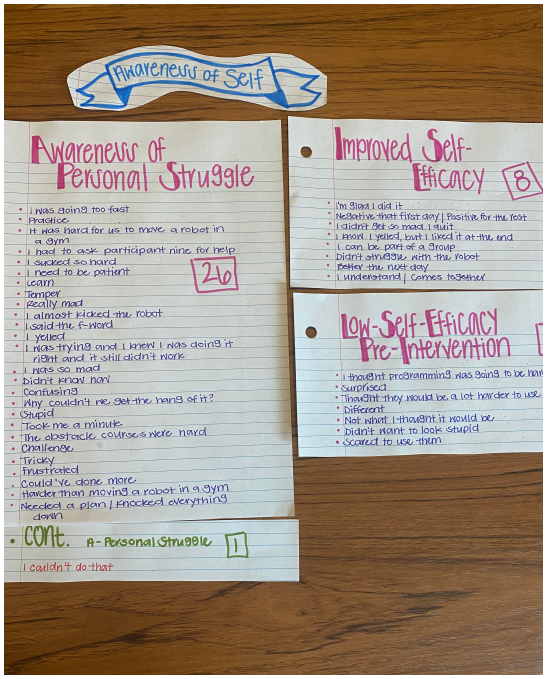

Figure 4.9
Patterns to Categories - 2

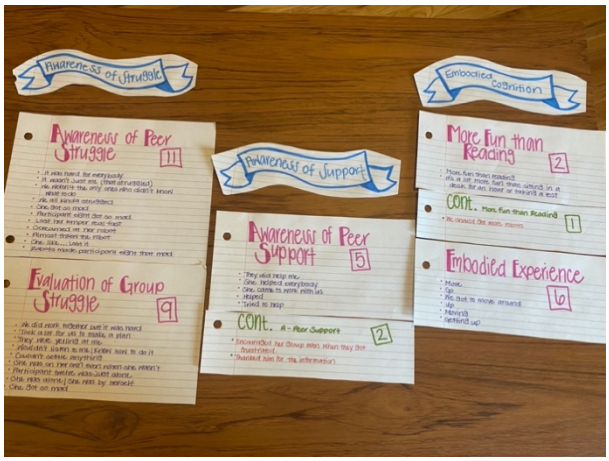

Figure 4.10
Patterns to Categories – 3

Prior to identifying themes within categories, the researcher stepped away from code examination. Additionally, the researcher conferred with the dissertation chair, in order to form a new perspective related to the data. This ensures that data is evaluated fully through multiple lenses (Saldana, 2021). Categories were grouped together by similarity of response. The researcher then wrote themes to appropriately convey the underlying message contained in the data set. As the result of this stage of analysis, three themes were identified. One category was eliminated as an outlier. Figure 4.11 shows the final display of themes, categories, patterns and codes.

In summary, qualitative data analysis produced 202 codes. These codes were refined into 13 patterns. The patterns were refined to five categories. Finally, the categories were refined to three themes. To ensure the accuracy of the data analysis, member-checking was employed. All participants were consulted a second time, in order to verify the accuracy of the responses and the accuracy of classifications (Onwuegbuzie et al., 2016; Saldana, 2021). Every participant both verified the accuracy of response and agreed with classification. Findings are presented next.

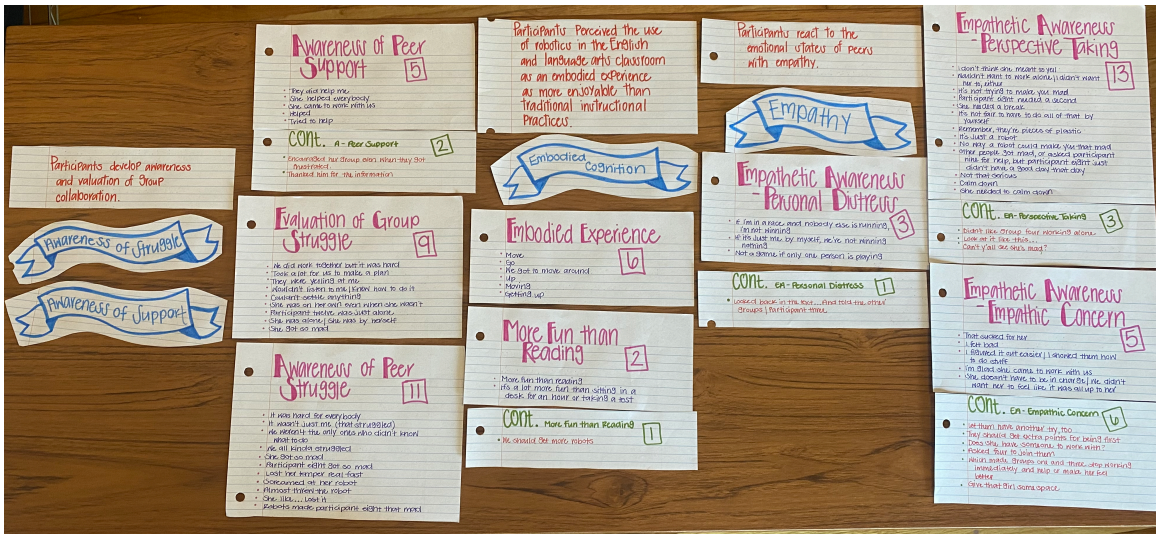

Figure 4.11
Categories to Themes

Presentation of Findings

The study's qualitative field notes and interview transcriptions yielded three themes. These themes, along with category, pattern and sample code counterparts are depicted in Table 4.8. As an example, the In Vivo transcript code "I felt bad" paired with the In Vivo field note code "Does she have someone to work with?". These codes indicated empathy for peers. They formed a portion of the pattern "Empathetic Awareness – Empathic Concern". This pattern was then paired with similar displays or statements of understanding related to empathy – "'Empathetic Awareness – Personal Distress" and "Empathetic Awareness – Perspective Taking" – to form the category "Empathy". This category then went on to become a major theme in the data.

Table 4.8 Themes within the Qualitative Data

Theme	Category	Pattern	Sample Code
Participants react to the emotional states of peers with empathy.	Empathy	Empathetic Awareness – Personal Distress	"Not a game if only one person is playing" - Interview Transcripts / Ichabod Crane
		Empathetic Awareness – Perspective Taking	"I don't think she meant to yell" – Interview Transcripts / Peter Vanderdonk
		Empathetic Awareness – Empathic Concern	"That sucked for her" - Interview Transcripts / Baltus Van Tassel
Participants perceived the use of robotics in the English and language arts classroom as an embodied experience as more enjoyable than traditional instructional practices.	Embodied Cognition	More Fun than Reading	"It's a lot more fun than sitting in a desk for an hour or taking a test" – Interview Transcripts / Ichabod Crane
		Embodied Experience	"We got to move around" – Interview Transcripts / Diedrich Knickerbocker
Participants develop awareness and valuation of group collaboration.	Awareness of Struggle	Awareness of Peer Struggle	"It wasn't just me (that struggled)" – Interview Transcripts / Baltus Van Tassel
		Evaluation of Group Struggle	"They were yelling at me" – Interview

			Transcripts / Diedrich Knickerbocket
	Awareness of Support	Awareness of Peer Support	Encouraged her group even when they got frustrated – Field Transcripts

Theme 1: Participants react to the emotional states of peers with empathy.

The first theme involves the idea that participants were able to recognize periods of struggle, both experienced by individuals and groups, as well as support offered to and by classmates in times of need. This is indicative of heightened empathetic awareness and emotional intelligence (Altwijri et al., 2021; Goldie, 1999). This theme includes the category "Empathy". This theme includes the patterns "Empathetic Awareness – Personal Distress", "Empathetic Awareness – Perspective Taking" and "Empathetic Awareness – Empathic Concern". The theme contains 21 In Vivo codes generated from analysis of the interview transcripts and ten In Vivo codes from the researcher's field notes. The alignment of theme to research questions is depicted in Table 4.9.

Empathetic Awareness – Personal Distress. This pattern encompasses responses, behaviors and statements by participants that indicate discomfort or anxiety during the intervention (Carrera et al., 2012). The discomfort illustrated stemmed from two sources in relation to peers: a) inequity in understanding or synthesis of the text or b) lack of robotics ability. In both cases, participants sought to even the playing field. This was accomplished by providing information to the other teams in order to encourage true competition.

Katrina Van Tassel possessed an innate robotics ability the researcher remarked on in the field notes. During activities, the divide between Katrina Van Tassel's ability and the abilities of her peers was obvious. Rather than pride, she immediately felt discomfort, as the most skilled operator. Her statements in the interview are indications of that personal distress. While she wanted to win the issued challenges, she was equally concerned with the performance of her classmates and looked for opportunities to help. She indicated that felt compelled to do so because the activities came so naturally to her.

Ichabod Crane also exhibited anxiety during the intervention. During the second activity, which required participants to use the robots to convey correct responses to riddles, he consulted the text when confronted with a particularly specific question. Instead of keeping the information to himself, or using it to the advantage of his singular group, he shared it with the rest of the class. The researcher noted this behavior in the field notes. When questioned about this behavior in the post-intervention interview, he indicated it was not enjoyable to be the only one who knew an answer. Like Katrina Van Tassel, he wanted to succeed, but didn't want to succeed at the expense of his peers.

Empathetic Awareness – Perspective Taking. This pattern encompasses responses, behaviors and statements by participants that indicate an ability to see things from alternate points of view (Lamm et al., 2007). The responses recorded primarily correlated to two root causes. First, participants witnessed the frustration and emotional breakdown of a peer during the starter challenge. Second, participants witnessed one group struggle when a peer was ambivalent toward the activities.

During the starter challenge, which required participants to maneuver through an obstacle course constructed of plastic cups using provided directions, Brom Bones

suffered technological setbacks. In her words, she was told to “download the app” on her phone and “pair it to the robot”. She did that successfully; however, the pairing was lost when participants moved from the English and language arts classroom to the gym. Brom Bones stated “my robot kept losing the connection and it just stopped working”. It was re-paired to the phone multiple times, to no avail. Following this, Brom Bones lifted the robot as if to throw it and yelled profanity.

Brom’s peers witnessed the breakdown and expressed their sentiments during the closing interviews. Baltus Van Tassel felt there as “no way a robot could make you that mad” and attributed her outburst to larger problems in her life. Major Andre was of a similar opinion, stating “I don’t think she meant to yell”. Both sentiments are emblematic of considering the events not only from personal perspectives, but also from Brom Bones’. Field notes add an additional layer of observation, with the researcher recording that during the outburst Katrina Van Tassel asked the rest of the class to “give her some space” and questioned “Can’t y’all see she’s mad?” before offering assistance.

The second most common root of the statements illustrating an ability to take the perspective of another into account was the struggle of group four. Group four was comprised of two members – Tom Walker and Old Scratch. Tom Walker was absent one day during the intervention. Her peers expressed a desire to work with her, because they “wouldn’t want to work alone” and “didn’t want her to, either”. The researcher also noted the the sentiment in the field notes, stating that Rip Van Winkle specifically, “didn’t like” that Old Scratch was working alone and that, due to her partner’s ambivalence, seemed alone “even when she wasn’t”.

Empathetic Awareness – Empathic Concern. This pattern encompasses responses, behaviors and statements made by participants that indicate compassion and sympathy toward peers (Hodges et al., 2010). The statements originated from a variety of stems. During the final activity, participants seemed compelled to advocate for peers and multiple people were concerned with Old Scratch remaining the sole competitor on her team.

The final activity required participants to complete an obstacle course constructed of plastic cups and glow sticks while left completely in the dark. Progress was purposefully impeded by the researcher using tennis balls. The field notes provide deep insight into this experience, indicating several key statements that express empathic concern. When group three was selected to go first, the remaining groups stated "They should get extra points for being first", even suggesting additional "tries" to complete the course when the other teams had a chance to move through it. This outpouring of compassion is indicative of empathic concern (Hodges et al., 2010).

The same level of consideration is evident in peer reactions to group four being disbanded. Major Andre, part of group two, reflected after Old Scratch joined them in the last activity. She stated "I'm glad she came to work with us" because she was not having the best experience prior to. The other members of group two asked Old Scratch to join before the assignment. Additionally, they questioned whether Old Scratch had anyone to work with while students prepared for the activity in the gym.

Summary. Participants exhibited emotional awareness during the intervention and in reflection post-intervention. This awareness represented three of the four subscales most commonly associated with empathy (M. Davis, 1980). Anxiety and unease were

aroused during the intervention, as some participants excelled while their peers struggled. This correlates to the subscale of Personal Distress (Carrera et al., 2012). Obstacles and challenges faced by peers created opportunities for participants to consider alternate viewpoints. This correlates to the subscale of Perspective Taking (Lamm et al., 2007). Finally, feelings of sympathy and compassion were extended. This correlates to the subscale of Empathic Concern (Hodges et al., 2010).

Theme 2: Participants perceived the use of robotics in the English and language arts classroom as an embodied experience as more enjoyable than traditional instructional practices.

The second theme involves the idea that participants rated the robotics intervention as more engaging than standard instruction in an English and language arts classroom. This is indicative of a preference for kinesthetic modalities as a means to support abstract content (Hwang et al., 2020). This theme includes the category "Embodied Cognition". This theme includes the patterns "More Fun than Reading" and "Embodied Experience". This theme contains eight In Vivo codes generated from analysis of the interview transcripts and one In Vivo code from the researcher's field notes. The alignment of themes to research questions is depicted in Table 4.9.

More Fun than Reading. This pattern encompasses responses, behaviors and statements by participants that indicate participating in a tactile activity was a more enjoyable instructional method than simply reading while seated in a desk. Participants one and ten indicated some variation of the statement "It was more fun than reading" during the post-intervention interview. Diedrich Knickerbocker indicated it was "way" more fun than reading. Rip Van Winkle indicated "I hate reading" but expressed

excitement about using the robots. Major Andre felt the kinesthetic opportunity was “a lot more fun than sitting in a desk for an hour or taking a test”.

The researcher noted prolonged engagement in the field notes, supporting these claims. During the first activity, Dame Van Winkle was identified as “surprising” because he was never overly engaged in the course, but made sure to stay on task during the challenge. Also, Tom Walker was a chronic absentee, missing two days per week on average. Over the course of the challenge, she missed approximately one day and was saddened by what went on in her absence.

Embodied Experience. This pattern encompasses responses, behaviors and statements by participants that indicate the learning activity was kinesthetic, or forced movement. Nearly all of the In Vivo codes classified within the pattern “Embodied Experience” were elicited during the post-intervention interview phase after participants were asked the following question: What three words come to mind when you picture yourself completing the robotics activities? Baltus Van Tassel responded with the words “move” and “go”. When asked to clarify, Baltus stated “We got to move around”. Ichabod Crane responded with the word “moving”. Rip Van Winkle responded with the word “up”. When asked to clarify, Rip stated “out the desk”. Judith Gardenier provided “I liked getting up”.

Summary. Participants expressed a preference for robotics, as operatives of embodied cognition, over accepted practices of literature instruction. The activities were deemed engaging and enjoyable. Participants considered them to be fun. They were also kinesthetic, by nature, and fostered the delivery of content standards and increased transfer. Participants consistently referred to movement and physical action.

Theme 3: Participants develop awareness and valuation of group collaboration.

The final theme involves the idea that participants establish a consciousness of the ability to cooperatively function in order to achieve a common goal. Collaboration is the keystone of working in a competitive, global market (J. T. . Thomas, 2017). This theme includes the categories "Awareness of Struggle" and "Awareness of Support". This theme contains the patterns "Awareness of Peer Struggle", "Evaluation of Group Struggle" and "Awareness of Peer Support". This theme contains 25 In Vivo codes generated from analysis of the interview transcripts and one In Vivo code from the researcher's field notes. The alignment of themes to research questions is depicted in Table 4.9.

Awareness of Peer Struggle. This pattern encompasses responses, behaviors and statements by participants that indicate an observation of the adversity and struggles faced by classmates. The In Vivo codes contained within this pattern relate to two broad topics. To begin, participants realized that individual struggles were not singularly individual struggles. They were, in fact, the same struggles faced by most participants, in every group. Then, participants observed the emotional meltdown of Brom Bones as a manifestation of struggle.

Major Andre indicated that this realization occurred during the first activity, when everyone was "kinda struggling to figure out how to work" the robots. He realized that every group would face an identical obstacle in that none of them had real experience with robotics technology. It made him feel "better" that he was not alone in floundering.

When interviewed by the researcher, Baltus Van Tassel expressed that, prior to Brom's meltdown, she assumed her group was the only one struggling. She indicated that "until Brom started hollering" she did not realize "it was hard for everybody".

After being unable to keep her phone successfully paired to her group's assigned robot, participants in the intervention witnessed Brom Bones' visceral frustration. Juditch Gardenier and Major Andre remarked that Brom "got so mad". Peter Vanderdonk indicated Brom Bones "lost her temper real fast" while Rip Van Winkle described how she "screamed at her robot". These are all markers for keen observation of other people struggling.

Evaluation of Group Struggle. This pattern encompasses responses, behaviors and statements by participants that indicate an observation of the adversity and struggles that accompany prolonged collaboration with peers. The In Vivo codes that comprise this pattern directly relate to the pitfalls in the process of working together toward a common goal. They address two predominant concerns: a) that working together could be accomplished, though it was difficult and b) that collaboration in group four was not present.

Diedrich Knickerbocker indicated that collaboration was possible, but that it "took a lot for us to make a plan". Also, that the group "did work together, but it was hard" and that, at first, the group struggled to "settle anything". This was also voiced by Rip Van Winkle, who felt that the rest of the group "didn't listen sometimes" even when correct answers were provided.

Katrina Van Tassel pointed to the lack of cohesion in group four by indicating that Old Scratch was "on her own even when she wasn't". This statement indicates that

Tom Walker was ambivalent in regard to the activities and did not work well with her partner. Brom Bones, Rip Van Winkle and Peter Vanderdonk affirmed this in their own statements, declaring “Old Scratch was just alone”.

Awareness of Peer Support. This pattern encompasses responses, behaviors and statements by participants that indicate and observation offered and received during the intervention. The predominance of the In Vivo codes associated with this pattern refer specifically to “helping”. Katrina Van Tassel “helped everybody”. Peter Vanderdonk received help. Ichabod Crane explained that Rip Van Winkle helped Old Scratch when her partner was disinterested.

The researcher also documented evidence of helping in the field notes. In the first challenge, Nicholas Vedder “encouraged her group even when they got frustrated”. At the inception of the robotics activities, when groups were functioning on a learning curve, Nicholas Vedder stepped up to give words of consolation and confidence to her peers. She reminded them that no one was completing the challenges with ease.

Table 4.9 Themes to Research Question

Research Question	Theme
1. How does the use of robotics impact Sleepy Hollow High School English III students’ levels of empathy?	1: Participants react to the emotional states of peers with empathy. 3: Participants develop awareness and valuation of group collaboration.
2. What are student perceptions of the use of robotics in the English III classroom at Sleepy Hollow High School to impact empathy?	2: Participants perceived the use of robotics in the English and language arts classroom as an embodied experience as more enjoyable than traditional instructional practices.

Summary. Participants expressed an understanding of the positive and negative connotations of group collaboration. Observations of struggle were provided, both on an individual level and a group level. Participants compared their own progress with that of other groups, making inferences and revisions to planning. They also expressed moments of realization, when they recognized that everyone struggled. Pitfalls of group work were identified. Additionally, instances of support and aid were discussed.

Chapter Summary

This mixed-methods study relied on quantitative and qualitative data to determine the impact of a robotics intervention in an English and language arts classroom, as well as student perceptions related to the intervention. Quantitative data was collected using the Interpersonal Reactivity Index administered both pre- and post-intervention, as well as a Personal Reflection Survey administered post-intervention. Qualitative data was collected using the researcher's field notes and via individual interviews with all participants. Quantitative data indicated an impact was made on overall IRI scores and scores in the subscale of Fantasy. Qualitative data indicated that three themes emerged a) participants reacted to the emotional states of peers with empathy, b) participants perceived the use of robotics in the English and language arts classroom as an embodied experience as more enjoyable than traditional instructional practices, and c) participants developed awareness and valuation of group collaboration. Findings and directions for further study will be discussed in the next chapter.

CHAPTER 5

DISCUSSION, IMPLICATIONS AND LIMITATIONS

Introduction

The purpose of this action research study was to evaluate the effect of a robotics-based initiative on empathy for students enrolled in English III at Sleepy Hollow High School. Following the dictates of the mixed-methods research design, both quantitative and qualitative data were collected (J. Creswell & Creswell, 2018). Quantitative data were collected through the administration of the Interpersonal Reactivity Index both pre- and post-intervention, as well as through a Personal Reflection Survey administered post-intervention. Qualitative data were collected from field notes and researcher documentation, as well as through individual interview with each of the study's participants. Index scores, survey responses, field notes and interviews were analyzed to answer the following research questions:

1. How does the use of robotics impact Sleepy Hollow High School English III students' levels of empathy?
2. What are student perceptions of the use of robotics in the English III classroom to impact empathy?

This chapter combines the findings of this research with previous research through the following sections: (a) discussion, (b) implications, and (c) limitations.

Discussion

To fully answer the proposed research questions, quantitative and qualitative findings were blended. An analysis of the intervention's impact on empathy is framed by existing research related to empathy, robotics interventions in the K-12 environment and the effect of emotional intelligence on academic and career success. The basis of embodied cognition as an instructional modality is also presented. The findings are organized by the study's research questions.

Research Question 1: How does the use of robotics impact Sleepy Hollow High School English III students' levels of empathy?

Empathy among American young adults is declining (Sara Konrath et al., 2011). This decrease in one major facet of emotional intelligence has a marked impact on longitudinal personal and professional success (Bryner, 2010; Gruhn et al., 2008; Lopes et al., 2016; Parker et al., 2017). Robotics have been pioneered as manipulatives integrated within artificial social scenarios to impact existing empathy levels among both geriatric and special needs populations (Lasley, 2017; Patrizia Marti & Stienstra, 2013). The intervention implemented in the described study required participants to work collaborative and interact with Wonder Workshop Cue robots in order to complete challenges centered around issued literary text.

Quantitative Findings

Analysis of the quantitative data included evaluating the shift in participant scores on the Interpersonal Reactivity Index administered pre- and post-intervention, as well as evaluating Personal Reflection Survey responses. This analysis reflected an impact on

participants' empathy levels. As the result of the robotics intervention, participants' overall empathy scores and scores on the subscale of Fantasy significantly improved. Participants were also better able to understand the concept of empathy and its importance in longitudinal success.

The increase in participant scores on the IRI demonstrates that after participation in the intervention, participants had higher levels of generalized, self-reported empathy. They were better able to recognize, appreciate and respond to the perceived experiences of peers even when those experiences differed from their own (Goldie, 1999; Mayer et al., 2008). This belies a shift in both the cognitive and affective domains of empathy (Lucas-Molina et al., 2017). Participants acknowledged appropriate scenarios in which they should extend compassion to peers and were able to complete that extension.

The increase in IRI scores also demonstrated that, after the intervention, participants had higher levels of empathy specifically within the subscale of Fantasy. Fantasy measures an individual's ability to empathize with fictional characters displayed through text or multimedia (M. Davis, 1980). This subscale correlates to the cognitive domain (Cuff et al., 2014). This has long been viewed as the more innate component of empathetic responses (Ganczarek et al., 2018).

Participant feedback on the Personal Reflection Survey provided evidence that, not only did the intervention make an impact, but that impact also registered with the participants. The young adults actively competing in the intervention's activities were better able to understand the broader concept of empathy as the result.

Qualitative Findings

Analysis of qualitative data supported this assertion. Interviews and field notes generated two themes that indicated an impact on participants' empathetic awareness. Firstly, participants reacted to the emotional states of peers with empathy. Secondly, participants developed an awareness and valuation of group collaboration.

Participants in the study react to the emotional states of peers with empathy.

Participants in the study provided statements that underscored an understanding of the two accepted domains of empathy: cognitive and affective (M. Davis, 1980; Goldie, 1999). Cognitive empathy was displayed in statements of perspective taking, demonstrating an ability to shift from inherent personal viewpoints to the viewpoints of others (Lamm et al., 2007). This indicates the presence of neural processes that allow for the consideration of alternate perspectives and valuation of the lived experiences of others (Decety & Lamm, 2006; Lamm et al., 2007).

Affective empathy was displayed in statements of personal distress and empathic concern. Statements of personal distress demonstrate building discomfort in times of turmoil (Carrera et al., 2012). This indicates an awareness of the struggles faced by peers and was followed by supportive action, documented in the researcher's field notes. Statements of empathic concern demonstrate compassionate exhibition toward others, an extension of sympathy and tenderness beyond the self (Hodges et al., 2010). This also indicates an awareness of obstacles and a desire to support.

Participants in the study develop awareness and valuation of group collaboration.

Participants in the study provided statements that underscored and understanding of interpersonal communication. This is an example of heightened emotional intelligence (Lopes et al., 2016). An awareness of struggle was documented, in relation to peers and in relation to group collaboration. An awareness of peer support was also found.

The intervention provided an environment in which struggle was inevitable, pairing participants with robotics technology previously unused. The struggle was then identified and voiced, in individual interviews. Verbal reaction and behaviors were also documented by the researcher. This recognition that the activities were difficult for everyone indicates a deeper understanding of perceived emotions in peers (Altwijri et al., 2021).

Participants also recognized that, apart from the activities, themselves, struggles also occurred within the parameters of each group. Communication patterns were slow to build. Arguments ensued. It was difficult to synthesize the opinions of others in order to form a strategy to work toward a common goal. This was reflected upon post-intervention and often accompanied sentiments of empathy toward other groups who faced identical issues. This recognition indicates a valuation of emotional intelligence as a necessary soft skill (Parker et al., 2004; Poonamallee et al., 2018).

Along with acknowledgement of struggle within the intervention, participants also identified evidence of support needed or offered by peers. Participants were able to appreciate when they had a more advanced skillset and appreciate how that skillset could best be employed in aiding peers. Participants were also able to appreciate when they

required assistance and were grateful it was given. The action of helping is another indication that emotional intelligence played a critical role in the robotics intervention (Lopes et al., 2016).

Summary

Quantitative and qualitative data, when integrated, illustrate that the robotics intervention made an impact on participants' empathy levels. This can be verified using nonparametric test results for the participants' overall scores on the Interpersonal Reactivity Index and for scores in the IRI subscale of Fantasy. From pre- to post-intervention administration, participant scores in these areas improved. Additionally, the Personal Reflection Survey illustrates that, as the result of the intervention, participants understand the concept of empathy.

This can also be verified with qualitative data. Researcher field notes and interview transcripts illustrate that participants were aware of struggles faced by peers, independently and within groups, and reacted to them using empathetic reasoning. Alternate perspectives were taken and empathic concern was demonstrated. Participants also became distressed at inequity of ability during the intervention and reached with support.

Research Question 2: What are student perceptions of the use of robotics in the English III classroom to impact empathy?

The use of robotic manipulatives is not uncommon in public, K-12 educational environments (Castro et al., 2018; Chevalier et al., 2020). They are, however, more often used within the domains of science, engineering, technology and mathematics (Sullivan & Bers, 2019; Zhong & Xia, 2018). There is great potential in harnessing robotics

technology as a means to impact emotional intelligence and social skills (Laurie et al., 2018; P. Marti & Stientstra, 2013). The intervention implemented in the described attempted to do such in an English and literature environment.

Quantitative Findings

Analysis of the quantitative data included evaluating participant scores on the Personal Reflection Survey. These scores indicated that participants had a favorable view of the robotics intervention, as a whole. They provided a positive depiction of the perceptions related to the use of robotics as a vehicle aimed at impacting empathy. They also acknowledged that the study's participants valued the experience as one that was entertaining and enjoyable. Additionally, the surveys led the researcher to conclude that participants understood the overall objective of the intervention was to impact empathy levels.

Qualitative Findings

Analysis of qualitative data lent support to this idea. The interview transcripts were evaluated. The field notes were perused. This process generated one theme that indicated positive participant perceptions related to the intervention.

Participants perceived the use of robotics in the English and language arts classroom as an embodied experience as more enjoyable than traditional instructional practices.

Participants in the study provided statements that expressed two primary sentiments. One, a preference for robotics manipulation over traditional literature instructional practices was underscored. Then, references to robotics manipulation as an experience of embodied cognition were presented.

The intervention's design allowed for activities and challenges that were atypical in the English and language arts classroom. In a standard, ninety-minute class period, students are repeatedly provided with materials that encourage reading comprehension. Physical modalities are not widely implemented or explored. Excitement and engagement during the intervention is documented in the researcher's field notes. In post-intervention interviews, participants also voice preference for robotics over test-taking and sedentary reading.

Statements also consistently reference movement. This kinesthetic aspect is evidence of the intervention as one that facilitates embodied cognition. Following the dictates of embodied cognition, rooting textual analysis for Washington Irving in physicality makes connections within the brain that can be stimulated in the future (Odendahl, 2021). This ensures higher rates of transfer and recall (Macrine & Fugate, 2021).

Summary

Quantitative and qualitative data, when integrated, illustrate student perceived the robotics intervention as a vehicle to impact empathy favorably. This can be verified using descriptive statistical analysis of the Personal Reflection Survey. Participants understood the purpose of the activities. Participants also found them engaging.

This can also be verified with qualitative data. Research field notes document participant engagement during the intervention. Interview transcripts detail statements of participants indicating two, overarching perceptions. Firstly, manipulating robots is considered more fun than reading in a desk. Secondly, manipulating robots simulates kinesthetic experiences that translate to opportunities for embodied cognition.

Implications

The findings from this research study have a variety of implications. As the ultimate objective for all of action research is iterative movement toward progress in a setting that is individual to the researcher, the data point in the direction of improved practice in a secondary English and language arts classroom (Mertler, 2017). This greatly influences the researcher, on a personal level, and argues for additional research in related fields of interest. Implications in this section are organized in the following sections: (a) implications for practice, (b) personal implications, and (c) future implications.

Implications for Practice

The data generated by this study add to the scant literature on impacting empathy with robotics technology in English and language arts classrooms, and the use of robotics in English and language arts classrooms as interventions, in general. The creative lens through which the study was situated indicate that both scenarios are beneficial for young adult learners. It is imperative that emotional intelligence becomes a direction of influence for public educators. It is equally imperative that robotics be used in realms apart from science, technology, engineering and mathematics.

Emotional Intelligence and Academics.

There is a distinct correlation between emotional intelligence and academic success (Altwijri et al., 2021; Parker et al., 2017; Suleman et al., 2019). A heightened grasp of the emotional states of others creates heightened interpersonal and communication skills and leads to a myriad of prosocial behavior, like planning and remaining goal-focused (Sara Konrath et al., 2015; Van der Graaff et al., 2018). More

empathetic people are more successful (Menolascino & Jenkins, 2018). Yet, largely this is ignored in classrooms.

Many young adults would benefit from empathy-driven learning experiences in K-12 classrooms. Following, many schools and communities would then benefit. These experiences could range from artistic exposure to dramatic performances (Gascon, 2019; Ziff et al., 2017). They could also incorporate technology, harnessing the pervasive exposure of our young adult population to social media and cellular capabilities (Sara Konrath et al., 2015). The goal of this would then be to impact existing empathy levels in order to impact academic performance.

The study described challenges the notion that only affective empathy can be taught, or coached, in young adults (Ganczarek et al., 2018). By impacting scores on the subscale of Fantasy, directly, participants have shown that cognitive empathy can also be influenced through targeted intervention (M. Davis, 1980). The implication of this is that there are methods with which we can reverse the noted decline in empathy among young adults to their benefit (Casale et al., 2018; Sara Konrath et al., 2011). These potential changes, then, are not singularly revisions to display or emotional output, but revisions to the thinking process and the feelings, themselves. They will give future generations tools to become better, more well-rounded communicators (Casale et al., 2018).

Robotics Beyond STEM.

The benefits of utilizing robotics technology in public education are incalculable (Castro et al., 2018; Jung & Won, 2018). Robots can teach young children spatial concepts, mathematical evaluation and phonetic language skills (Markievicz et al., 2017;

Zhong & Xia, 2018). They are engaging, iterative and can be implemented to foster collaboration skills. They are, however, largely ignored in liberal disciplines.

It is common to see robots in the fields of science, technology, engineering and math. Middle and high schools have robotics laboratories and robotics teams, crafting complex machines that compete in challenges for accolades. What remains largely unseen are immersive robotics experiences in the domains of history and/or English and language arts. With rates of functional illiteracy rising across the country, it is time to reevaluate the practice of teaching reading.

The qualitative data generated by this study supports the assertion that implementing robotics in a secondary English and language arts classroom was perceived by the students as engaging and kinesthetic. One key theme that emerged from the analysis of interview transcripts was the notion that using the robots allowed for, and even forced, a freedom of movement that transcended what would be taught with a sedentary approach. Student participants were up out of their seats, walking, pacing, crouching and actively engaging with the robots in a series of tactile challenges. The researcher's field notes further validated this by documenting the excitement and immersions of participants within the activities.

Twenty-first century learners require twenty-first century methods of instruction. As educators prepare young adults for careers that do not yet exist, the methods employed to capture the interest and inspire others should also shift to incorporate new generations of thought and new perspectives. Empathy-driven interventions are beneficial in an inter-disciplinary capacity to increase academic performance. Robotics in more liberal subject areas are an impactful way in which to accomplish this.

Personal Implications

The implications listed for practice are of a personal nature for me as the researcher, forming the backbone of action research (Mertler, 2017). I identified a problem of practice in my own environment and designed an intervention to target the problem. The findings of the study corroborate my long-held belief that robotics are not solely relegated to the domains of STEM. Also, it validates the assumption that empathy can be reinforced and impacted in the English and language arts classroom in order to immediately benefit the student.

My experiences with action research were both challenging and invigorating. It was difficult, at times, to be so invested in the problem I identified. It is a constant struggle to face apathy daily. However, I felt completely absorbed and fascinated by the participants' growth as they navigated the robotics challenges and synthesized the assigned texts. They experienced Washington Irving in a way most students have not and, as the result, were more engaged and are more likely to equate reading with fondness and positivity.

I am invigorated to seek out and pursue more avenues for the growth of emotional intelligence in young adults. There are a multitude of ways that this skillset can be integrated within existing curricula spanning disciplines and grade levels. Robotics and technology were an interesting start. They are an authentic, experiential way to capture and keep the attention of students of all ages (Venture, 2014). I found them to be easy to find, easy to purchase, and easy to use.

I plan to utilize the robots more in the upcoming academic year in a range of activities. I have worked to design vocabulary challenges, in which students would

maneuver the robots to different stations, identifying correct responses to provided questions. I have also worked to design assignments that feature the robots as actors in Shakespearean productions, relying on movement and basic sounds to convey the emotions in each scene of *Romeo and Juliet*. The possibilities are endless.

Robots and Empathy.

The findings of the study indicate that participants' levels of empathy were impacted based on what they did during the challenges. They were exposed to a technology that was otherwise foreign, required to use it, and then reflected on their experiences. Following, participants should score higher on state mandated assessments that gauge mastery of English and language arts content standards.

In the coming academic year, I plan to implement robotics initiatives in all English II courses at Sleepy Hollow High School, in order to affect a shift in student scores on the South Carolina Department of Education's End of Course Assessment for grade band 10. This assessment comprises a large portion of the State Report Card issued to Sleepy Hollow High School. If future interventions follow the pattern outlined in this study, scores would be positively impacted by positively impacting student empathy levels.

Future Implications

The findings presented here can guide future research. This study generated data that indicates two future directions of study. The first is the impact of robotics interventions in liberal disciplines. The second is interventions to impact empathy, specifically, in secondary environments.

Robotics in Liberal Disciplines.

The study made a correlation between the use of robotics technology in an English class and increased levels of empathy reported by the participants. The robotics were featured in a series of challenges designed by the researcher to highlight sections of assigned text. The impact of the study points toward a favorable opinion of using robotics in disciplines other than science, technology, engineering and math. Future research could further validate this assertion, framing the robotics intervention in theories of embodied cognition.

Secondary Empathy Interventions.

The study demonstrated that empathy levels among young adults are malleable. They can be impacted using in-class interventions designed specifically to target the cognitive and affective processes. Higher empathy levels are manifestations of higher levels of overall emotional intelligence. A heightened sense of emotional understanding directly relates to future success and longitudinal happiness. Future research into opportunities to implement empathy-driven interventions in secondary environments could be beneficial.

Limitations

Although the findings of the study are promising, there are several limitations. These limitations present areas where iterative design could be improved and future research could be conducted. First, there are limitations in relation to the participants. Second, there are limitations in relation to the quantitative data analysis. Finally, there are limitations in relation to the qualitative data collection and analysis.

Participants

The foundation action research is built upon is the study of problems specific to the researcher (Mertler, 2017). This occurs in contexts and environments that are equally specific unto the person conducting the research (J. Creswell & Creswell, 2018). Because of this requirement, large-scale sampling techniques are not typically involved. In their place, convenience sampling techniques were employed. It is possible that the data generated from action research studies, if conducted on a demographically difference sample, would yield different outcomes. This creates a hinderance in terms of generalizing the data for broader, more diverse application.

Quantitative Data Analysis

Quantitative data was collected from two sources. Firstly, the researcher administered the Interpersonal Reactivity Index pre- and post-intervention. Second, all participants completed a Personal Reflection Survey at the close of the intervention. There were mathematical concerns in relation to the scores generated by the Interpersonal Reactivity Index.

Participant scores, overall, increased from the pre- to post-administration of the IRI. Participant scores for the subscale of Empathic Concern, representing affective empathy, decreased from pre- to post-administration of the IRI. These scores shifted from .682 in the pre- to .621 in the post-. This could have been affected by a great number of extenuating circumstances and factors. It is possible that a third administration of the IRI would have provided a larger data set to fall back on.

Additionally, the Cronbach's alpha value that was calculated for the subscale of Perspective Taking, representing cognitive empathy, is considered unacceptable for

evaluating intervention significance (Taber, 2018). The average score for the subscale did increase from pre- to post-administration of the IRI. For this reason, it was included in the quantitative analysis in order to provide a deeper insight into participant results.

Qualitative Data Collection

Qualitative data was collected from two sources. Firstly, the researcher documented all participant interaction and reflected on each challenge in detailed field notes. Second, all participants were interviewed at the close of the intervention. Although the participant interview transcripts were analyzed by student participants, two limitations are present.

The interviews, themselves, were conducted by the researcher, a familiar presence to all participants. They were conducted in the English and language arts classroom, a familiar location for the participants. Interview questions aligned to the study's research questions were posed and follow-up questions were asked, based on participant responses. However, the interviews were brief, often less than ten minutes. It is a possibility that longer interviews would have yielded deeper insight into the process of the acquiring and demonstrating empathy.

Participants were asked to verify and evaluate their interview responses. Each participant was provided with the audio recording and the transcripts, transcribed by the researcher, personally. Four participants, or 31% of the sample, were uncomfortable with the audio, itself, although the accuracy of response was affirmed. For this reason, audio tracks are not being made available.

Qualitative Data Analysis

The analysis of all qualitative data was conducted by the action researcher. As the fundamental aspect of action research is identifying problems of personal practice, the practice of conducting analysis is also inherently personal (Mertler, 2017). This singular view, however unbiased, is a limitation in any study whose aim is to yield generalizable data. Determining themes is a subjective process. Were it conducted by a panel of researchers, or an entirely separate researcher, the interpretation of the data could differ from what is presented in this study.

Conclusion

The purpose of this action research study was to evaluate the effect of a robotics-based initiative on empathy for students enrolled in English III at Sleepy Hollow High School. Empathy is a key component of emotional intelligence, the largest social predictor of lifelong success for young adults (Altwijri et al., 2021; Suleman et al., 2019; Urquijo et al., 2019). However, empathy is on the swift decline among young adults in the United States (Sara Konrath et al., 2011). Interventions to impact empathy span disciplines and subject areas, and can include technology (Gascon, 2019; Sara Konrath et al., 2015; Ziff et al., 2017).

The findings generated by the study indicated that the use of robotics positively impacted students' levels of empathy and that students perceived the use of robotics in the English III classroom at Sleepy Hollow High school as an entertaining and engaging way in which to impact empathy. Implications of these findings include introducing emotional intelligence as a facet of curricula and advocating for the use of robotics technology beyond the realms of science, technology, engineering and math.

Additionally, the data collected does not support the belief that only the affective component of empathy can be influenced through targeted interventions (Riess, 2017).

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APPENDIX A

LIST OF SOUTH CAROLINA COLLEGE- AND CAREER- READINESS

STANDARDS FOR ENGLISH / EMPATHY

Table 6.1 List of SCCCR Standards for English / Empathy

Standard Type *Standard Number*	**Description of Standard Requirements**
Inquiry-Based Literacy Standard (I) Standard Two	Transact with texts to formulate questions, propose explanations, and consider alternative views and multiple perspectives.
Reading – Literary Text (RL) Standard Five	Determine meaning and develop logical interpretations by making predictions, inferring, drawing conclusions, analyzing, synthesizing, providing evidence, and investigating multiple interpretations.
Reading – Literary Text (RL) Standard Six	Summarize key details and ideas to support analysis of thematic development.
Reading – Literary Text (RL) Standard Eight	Analyze characters, settings, events, and ideas as they develop and interact within a particular context.
Reading – Literary Text (RL) Standard Nine	Interpret and analyze the author's use of words, phrases, and conventions, and how their relationships shape meaning and tone in print and multimedia text.
Reading – Literary Text (RL) Standard Eleven	Analyze and provide evidence of how the author's choice of point of view, perspective, and purpose shape content, meaning and style.
Reading – Informational Text (RI) Standard Five	Determine meaning and develop logical interpretations by making predictions, inferring, drawing conclusions, analyzing, synthesizing, providing evidence and investigating multiple interpretations.

Reading – Informational Text (RI) Standard Eight	Interpret and analyze the author's use of words, phrases, text features, conventions, and structures, and how their relationships shape meaning and tone in print and multimedia text.
Reading – Informational Text (RI) Standard Ten	Analyze and provide evidence of how the author's choice of purpose and perspective shapes content, meaning, and style.
Communication (C) Standard One	Interact with others to explore ideas and concepts, communicate meaning, and develop logical interpretations through collaborative conversations; build upon the ideas of others to clearly express one's own views while respecting diverse perspectives.
Communication (C) Standard Four	Critique how a speaker addresses content and uses craft techniques that stylistically and structurally inform, engage, and impact audience and convey messages.
Communication (C) Standard Five	Incorporate craft techniques to engage and impact audience and convey messages.

APPENDIX B

ACTIVITY HANDOUTS

OLD SCRATCH'S SWAMP

Follow the directions contained in the poem below to successfully maneuver through the obstacle course with prowess!
Refer to the point scale at the end in order to determine your overall results.

Commence by gently switching on
Your tiny robot friend,
Sync to your phone and be advised
To keep this connection to the end!

Drive your buddy to the space
That marks where the story was set;
Then drive your friend across the bridge
That crosses the "deep inlet".

Find in the story the date that's provided
When Irving introduces Tom Walker.
You'll need the third number to go through the oak trees
You best have it right, though, I'm kind of a stalker

There are six trees depicted, with space in between them
That you need to navigate down
But you have to circle each base the right number of times
If it's wrong I will turn you around.

Once you've crossed through the woodlands
Which really aren't woodlands because budget cuts are real,
It's time to climb forward and stay on the path
That leads you up a hill.

That path is quite narrow, I did that on purpose
To test your robot's agility
It's supposed to be hard, don't worry or scream
It's only measuring recent ability.

For every cup you tip in passing
For every move or shift
You lose five points off your score
Don't let this cause a rift.

Just take a breath and take your time
This situation is not dire
When you emerge from up the hill
You'll face the Devil's deep quagmire!

A TART TEMPER

Use the robots to convey the correct responses to the following riddles.
TEACHER GUIDE

1. The first U.S. city to have a subway system is also the setting of the first American example of Faust-inspired literature.
    a. Boston, Mass
2. Also called the "wild huntsman"
    a. Old Scratch
3. "Harsh-tempered or overbearing woman"
    a. Termagant
4. Another word for Blackbeard, Anne Bonney, and Captain Jack Sparrow
    a. Buccaneer
5. Another word for the Deadly Sin involving "coveting material possessions"
    a. Avarice
6. Approximately 1/3 of Americans do this daily and they are more common between the hours of 1p.m. and 3p.m.
    a. Nap
7. "..being that causes more perplexity to mortal man than ghosts, goblins, and the whole race of witches put together"
    a. A woman
8. "Not a limb, not a fiber of him was idle…" What was Ichabod doing?
    a. Dancing
9. Originally called New Amsterdam, this state is the setting of a drama featuring lust, intrigue and a ghost missing one key feature of the body.
    a. New York
10. Invented in China in the 9th century, what material shares its name with Ichabod Crane's borrowed horse?
    a. Gunpowder

"CAPTAIN KIDD'S TREASURE"

Student teams were issued the attached map and turned loose to visit classes on the English and science hallway. They were each given a different order to go in. Faculty volunteers supplied independent questions based on the text of Washington Irving and/or information related to American Romanticism. These questions are summarized below.

<u>One</u>

- How did Tom and his wife get along in *The Devil and Tom Walker?*
- What was the Devil's offer to Tom Walker?
- What cultural influences are apparent in *Rip Van Winkle*?
- What elements of *The Legend of Sleepy Hollow* indicate it's an example of American Romanticism?
- What kind of settlement was Tarrytown, New York? What cultural group founded the city?

**Students complained this teacher misunderstood the point of the activity and wanted the robots to be capable of much more in depth responses.*

<u>Two</u>

True or False: True, move the robot to the right. False, move the robot to the left.

- Tom Walker had a good relationship with his wife.
- Tom felt grateful to Old Scratch for killing his wife.
- Philanthropic is a good word to describe Tom Walker.
- The Headless Horseman was a Union soldier.
- Ichabod Crane was a minister.
- Rip Van Winkle was not an attentive or caring father / husband.

<u>Three</u>

Multiple choice dots on the floor – A, B, C, D. Move the robot to the correct dot.

1. The mountain range most closely associated with Rip Van Winkle.
    a. Appalachians
    b. Andes
    c. Catskills
    d. Poconos
2. Rip Van Winkle's family operated a farm. Which of the following words BEST describes the state of that property?
    a. Pristine
    b. Dilapidated

APPENDIX C

IRB DOCUMENTATION

OFFICE OF RESEARCH COMPLIANCE

INSTITUTIONAL REVIEW BOARD FOR HUMAN RESEARCH
DECLARATION of NOT RESEARCH

Susan Porter-Voss
1216 W Palmetto Street
Florence, SC 29501

Re: **Pro00113517**

Dear Mrs. Susan Porter-Voss:

This is to certify that research study entitled ***The Devil and Tom Robot: The Use of Robotics to Impact Empathy in Secondary Students of American Literature*** was reviewed on **8/31/2021** by the Office of Research Compliance, which is an administrative office that supports the University of South Carolina Institutional Review Board (USC IRB). The Office of Research Compliance, on behalf of the Institutional Review Board, has determined that the referenced research study is not subject to the Protection of Human Subject Regulations in accordance with the Code of Federal Regulations 45 CFR 46 et. seq.

No further oversight by the USC IRB is required. However, the investigator should inform the Office of Research Compliance prior to making any substantive changes in the research methods, as this may alter the status of the project and require another review.

If you have questions, contact Lisa M. Johnson at lisaj@mailbox.sc.edu or (803) 777-6670.

Sincerely,

Lisa M. Johnson
ORC Associate Director and IRB Manager

APPENDIX D

INTERPERSONAL REACTIVITY INDEX

Table 6.2 Interpersonal Reactivity Index

Statement	**Subscale**	**Scoring**
I daydream and fantasize, with some regularity, about things that might happen to me.	Fantasy	A-E Scored 0-4 (A=0, E=4)
I often have tender, concerned feelings for people less fortunate than me.	Empathic Concern	A-E Scored 0-4 (A=0, E=4)
I sometimes find it difficult to see things from the "other guy's" point of view.	Perspective Taking	A-E **Reverse** Scored 4-0 (A=4, E=0)
Sometimes I don't feel very sorry for other people when they are having problems.	Empathic Concern	A-E **Reverse** Scored 4-0 (A=4, E=0)
I really get involved with the feelings of the characters in a novel.	Fantasy	A-E Scored 0-4 (A=0, E=4)
In emergency situations, I feel apprehensive and ill-at-ease.	Personal Distress	A-E Scored 0-4 (A=0, E=4)

I am usually objective when I watch a movie or play, and I don't often get completely caught up in it.	Fantasy	A-E **Reverse** Scored 4-0 (A=4, E=0)
I try to look at everybody's side of a disagreement before I make a decision.	Perspective Taking	A-E Scored 0-4 (A=0, E=4)
When I see someone being taken advantage of, I feel kind of protective toward them.	Empathic Concern	A-E Scored 0-4 (A=0, E=4)
I sometimes feel helpless when I am in the middle of a very emotional situation.	Personal Distress	A-E Scored 0-4 (A=0, E=4)
I sometimes try to understand my friends better by imagining how things look from their perspective.	Perspective Taking	A-E Scored 0-4 (A=0, E=4)
Becoming extremely involved in a good book or movie is somewhat rare for me.	Fantasy	A-E **Reverse** Scored 4-0 (A=4, E=0)
When I see someone get hurt, I tend to remain calm.	Personal Distress	A-E **Reverse** Scored 4-0 (A=4, E=0)
Other people's misfortunes do not usually disturb me a great deal.	Empathic Concern	A-E **Reverse** Scored 4-0 (A=4, E=0)
If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.	Perspective Taking	A-E **Reverse** Scored 4-0 (A=4, E=0)

After seeing a play or movie, I have felt as though I were one of the characters.	Fantasy	A-E Scored 0-4 (A=0, E=4)
Being in a tense emotional situation scares me.	Personal Distress	A-E Scored 0-4 (A=0, E=4)
When I see someone being treated unfairly, I sometimes don't feel very much pity for them.	Empathic Concern	A-E **Reverse** Scored 4-0 (A=4, E=0)
I am usually pretty effective in dealing with emergencies.	Personal Distress	A-E **Reverse** Scored 4-0 (A=4, E=0)
I am often quite touched by things that I see happen.	Empathic Concern	A-E Scored 0-4 (A=0, E=4)
I believe that there are two sides to every question and try to look at them both.	Perspective Taking	A-E Scored 0-4 (A=0, E=4)
I would describe myself as a pretty soft-hearted person.	Empathic Concern	A-E Scored 0-4 (A=0, E=4)
When I watch a good movie, I can very easily put myself in the place of a leading character.	Fantasy	A-E Scored 0-4 (A=0, E=4)
I tend to lose control during emergencies.	Personal Distress	A-E Scored 0-4 (A=0, E=4)
When I'm upset at someone, I usually try to "put myself in his shoes" for a while.	Perspective Taking	A-E Scored 0-4 (A=0, E=4)

When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me.	Fantasy	A-E Scored 0-4 (A=0, E=4)
When I see someone who badly needs help in an emergency I go to pieces.	Personal Distress	A-E Scored 0-4 (A=0, E=4)
Before criticizing somebody, I try to imagine how I would feel if I were in their place.	Perspective Taking	A-E Scored 0-4 (A=0, E=4)

Link to Google Slide:

https://docs.google.com/presentation/d/1RIOn_n4ucMcflowz-R_vfwzv9e2Mor2fSiksdyP9j94/edit?usp=sharing

APPENDIX E

PERSONAL REFLECTION SURVEY

I feel the robotics intervention DID impact my personal level of empathy.

I feel the robotics intervention was engaging.

I understand the purpose of the robotics intervention.

I understand empathy.

There were times during the intervention when I noticed my own level of empathy (either toward my team members or other teams).

Strongly Disagree – 0

Strongly Agree - 4

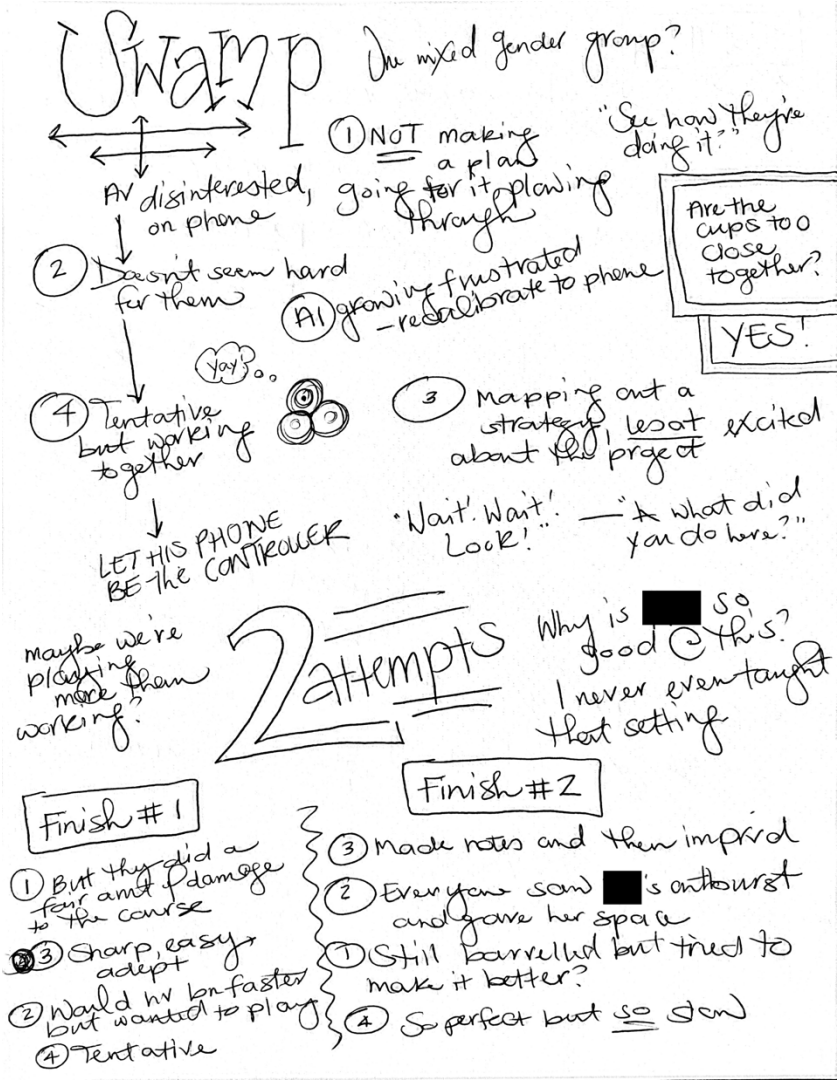
APPENDIX F

INTERVIEW QUESTIONS

1. Can you tell me about a time you struggled with the robots?
2. Did you notice your classmates struggle?
3. How did that make you feel?
4. Going through the exercise, do you feel differently about early American settlers?
5. Tell me about your experience with the robots.
6. What are your impressions of the robotics activities?
7. What three words come to mind when you picture yourself completing the robotics activities?

APPENDIX G

FIELD NOTES



HELPING } 3 helped 2 after A's outburst, knew answer but remote connection was lost?

"Can't y'all see she mad?"
"Give that girl some space."
"Look at it like this."
"Turn it upside down."

Tech is imperfect
Tries patience
That's the point

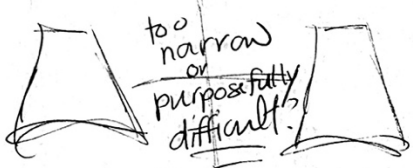
"If we slide them a little apart..."
"Have that word..." (E)

"We did it-"
"I feel like"

I told her they would knock it all down? If she was big mad

4 walked quietly thru the maze
→ "You did a good job @ the curve. I couldn't do that."

"I can make yours just follow mine, look up if that's a thing



1 Hands off (@ first) but was med up, needs to be reminded it's ok to be silly sometimes

2 Never used a robot before but loves video games, engaged the activity and moving around

3 The calm "leader" of Group 1, good balance of work and play, felt really responsible for helping everyone around him.

4 Very disinterested up until AI's issue, then stepped up

5 Knew the info from the short stories & Romanticism but out of her element w/ modality

6 Skeptical but switched gears when her teammate needed help

7 Surprising b/c he doesn't like class but was excited to do this, prepared, remembered robotic commands

8 Got really frustrated b/c her robot didn't connect well to the phone, outburst

9 Took to this like a fish to water, could make the robot do things I didn't teach them

10 Adept, adaptable, may struggle w/ bigger syntheses of activity to text

11 I worry the chronic absenteeism will affect these activities, good today but hesitant to do a lot

12 Patient w/ group member but btwn the two of them, someone has to do something

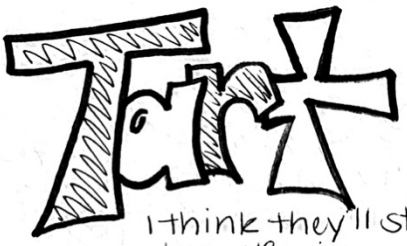
13 Breath of fresh air for her group b/c she's even-keeled and reflective when they fail

Outburst

Group 2 struggled to connect the robot to the cell phone as a controller. One member had an issue and screamed "It won't fucking work!" which made Groups 1 & 3 stop and help or try to make her feel better. They offered solutions.

Revision

Different phone & different robot tomorrow.



- Team 4 missing one
- Team 1 had a tardy member
- Team 2 has a new robot and a different phone operator.

I think they'll struggle to synthesize and operate.

1. Boston, Mass
   "The first U.S. city to hv a subway system is also the setting of the first American example of [redacted] Faust-inspired literature."

4 was lost | said Boston, too | not fast enough but used recorder to say Boston

#1 Group 2

creative Group 3 used phone w/ map of Boston and robot to point

2. Old Scratch
   "Also called the Wild Huntsman."

#1 I said "Old Scratch"

creative 4 made the scratching sound

everybody said Devil on the first try, took 2 before somebody looked back in the text and told the other 3 groups

Groups 2 & 3 said thank you for the information

3. Termagant
   "Harsh-tempered or overbearing woman..."

#1 creative > same! I ran their robot up to me, asked for clarity and were able to define it in the 10 & C time

The other 3 groups had no idea but laughed and told 1 good job — hope they remember me on SAT :-

4. Buccaneer
   "Another word for Blackbeard, Anne Bonney and captain Jack Sparrow."

#1 3, said it

creative 2 tried to play the yo ho ho song but we were looking for the actual term

everybody said pirate first took 2 tries, 3 got it w/no outside help

Art "Could have use a $1, buck?"

5. Avarice
   "Another word for the deadly sin involving coveting material possessions."

#1 1, said it

creative this one was hard to be creative w/ (might give up b/c 1 is fast)

3 said adultery first "not in the book"

Me: Try to do it w/o the words..."

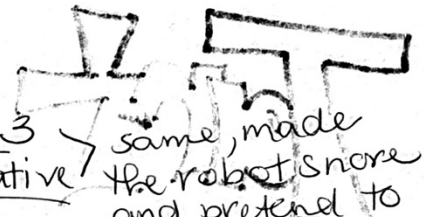
6. Nap

"Approximately 1/3 of Americans do this daily and they are more common [redacted] btwn the hours of 1pm and 3pm."

EASY

#1 3 > same, made the robot snore and pretend to be asleep
creative

Still impressed w/how AA can make it do things I didn't teach



7. A woman

"..being that causes more perplexity to mortal man ghosts, goblins, and the whole race of witches put together."
not difficult for them, must hv paid attention here :

#1 2 > raw robot to me
creative not a bad idea
could hv pntd @ any girl

"Why are we perplexing"
"That's not even fair"

8. Dancing

"..Not a limb, not a fibre of him was idle..."

Ichabod

Took a minute for anyone to respond, got sleeping and then kissing sounds?

#1 1, said dancing
creative 3, made the robot dance

"I forgot it did that"
"Where's that control?"
"Can you show me."

9. New York

"Originally called New Amsterdam, this state is the setting of a [redacted] drama featuring lust, intrigue and a ghost missing one key feature of the body"

2 + 4 consolidated
#1
creative 3, quick on the draw to show me a pic of the State of NY (remembered to be fast from the last time)
→ "It was Dutch something

10. Gunpowder

"Invented in China in the 9th century, what material shares its name w/ Ichabod Crane's borrowed horse."

#1 1, said gunpowder
creative 2, made fireworks/siren sounds w/robot

1 Knew most of the answers they got right, felt it was just more productive to say than demonstrate

2 Controlled the robot, got outvoted on how to demonstrate b/c he didn't like "just saying it", ran it up to me for term "she'll get it"

3 Knew answers, very straightforward w/ his delivery, looked back in text for "Old Scratch" and told the other groups

4 Knew answers but I wish he'd be more vocal, he remembered the Butch part, seemed disinterested but didn't like 4 alone

5 Logical, took turns controlling the robot while other 2 knew answers, asked 4 to join

6 Took turns w/ control, had creative ideas about how to deliver the info

7 Brainstormed for answers, surprising recall w/ this modality that I've not seen

8 Brainstormed for answers, much calmer w/ ideas and not the control

9 Still impressed that she can make it do so much, ended up being the one everyone else consulted about how to work it

10 Had to come up w/ the answers, much calmer than I thought, enjoyed the lighthearted part of this

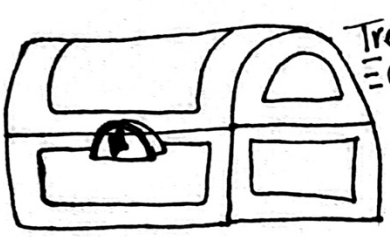
11 X

12 Completely lost trying to find answers & control, helped a lot by 4, joined Group 2

13 Encouraged her Group when they got frustrated

Revisions →

Max on how many times the robot can speak



I predict they'll be silly in the hall and race :)

Captain Kidd's treasure

- I didn't mk any of the questions.
- Everyone present and on time.

Rules

Wanted same robots from yesterday
Discussing who would talk in front of teachers, where they would start (like a hunt).
will wander around.
Not complaining

"Art, how do you..."
"Wait, sh got somebody to work with?"

Teacher Convos

One

ong-winded questions that couldn't use the robots to the fullest
irst group was a struggle, didn't understand robot limitations
hey were patient (3) and helped figure out how to do it

(2) most correct
(4) slowest
(1) most organized group roles, seemed to take it the most seriously "Don't listen."

"I liked showing off what they could do"

wanted them each to put on a show for her

"Why is he so smart?"

Two

only did T/F (right or left)

(3) fastest and best control of robot, also surprisingly well read or knew the text
(4) most polite, thanked for your time
(1) second fastest, said they aprctd his system
(2) didn't know as many but knew how to control

Three

*had seen and used the robots before

made M.C. dots on the floor

kids liked his the best, he said they told him

(3) showed the next group how to do it

(2) most right, "spot on"

(4) most determined

(1) most excited to show off the moves of the robot

thought the lesson really gave everybody the opportunity to do something on a team (is a coach)

Four

asked about character's emotions

kids demonstrated w/ robots using movement + sound (love this idea)

(3) most impressive, got it, made it happen

(2) close second, got it but 3 was better w/ control

(1) interacted w/ robot like it was a person "could not get enough"

(4) tried

Closing

Didn't like Door One, thought she should see a demo of the robots before she did it again.

Would like more distance challenges b/c using robots in the hall was fun.

Took them into other classes to show them off, how to answer questions T/F + MC

Don't love the approach of Door Four but that's probably the most complete synthesis

Revisions

- Split up 4
- Have everyone learn from 3
- Demo robots for adult participants

1 Took a backseat this time, that was unusual

2 Let someone else control the robot

3 Did most of the talking

4 Stepped up

5 Showed off how much she knew, impressed the other teachers, kept everyone quiet in the hallway

6 Was nervous in front of other people, but managed to shake it off

7 Never gets rattled, seems to always be in control and understands more than I give him credit for

8 Got to control again and wasn't bothered @ all by small setbacks, helped another group w/ theirs

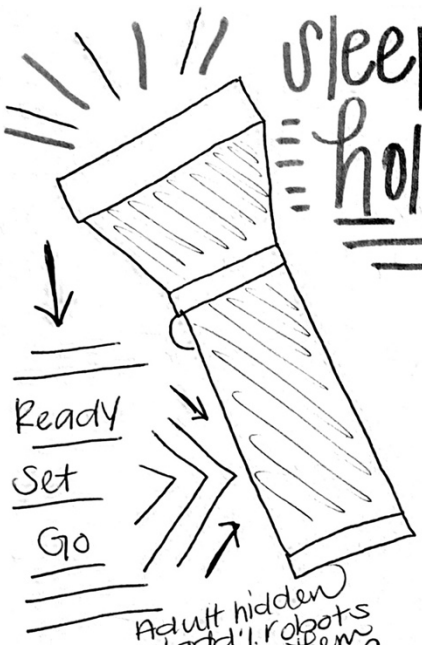
9 Every teacher's fav

10 A great knowledge backup for Art, work really well as a team

11 > together are too nervous, they're great supports but no one wants to take the primary role

12

13 Usually along for the ride but was the most excited to show her work off in other classes



sleepy hollow

- Should 4 be split and combined?
  — YES —

I predict this will be the least stressful of all challenges and will really foster a sense of competition.

- Forgot to turn off all gym lights.

"You need me to do it? I do it for basketball."

"Not it to find who goes first"

ONE AT A TIME

"They should get extra points for being first"

(3) up first
flashlights from phone, glow paint
not fans

w/ Watch to see what they do"

but AA is really good w/ the robot, missed the 2x b/c she saw it coming

"Let them go again when everyone is done"

↳ "I over two times"

followed wrong path and had to back out

"Girl should drive a race car"

all 4 worked together, no one yelled, 3 gave directions and AA kept control the whole time

"Let them name who goes next"

(1) picked for second
better able to navigate @ the b'ging but 3 are very critical of the one driving

Group 3 is helping
Slowed pace... and that resulted in being knocked off course by [redacted] and put back on start "Let them have another try, too"
Speedier, made it, but switched control partway thru
AV had really good insight abt movement

(2) picked for third
AV driving others telling her to take her time
other groups warning her about the obstacles
She listens and does really well
"Can we do it again so they can have a turn, too?"

FREE PLAY Everyone who wanted to got a chance to drive thru the obstacle course
Students took turns running the obstacles
They were not aggressive in their running of said obstacles at all
We should get more robots"

Revisions
More structure
Time limits w/ control
like a 4x4.

1 Unexpectedly got a lot out of this

2 Expectedly got a lot out of this b/c he does well w/ his hands

3 Not surprised that he got the knowledge part of this activity (or the leadership) but love that he got something from the tech, too

4 Didn't open up a lot before this, but seeing Group 4 either alone or struggling really made him come out of his shell and I love that

5 Really didn't see her engaging the tech part of this intervention but she was so competent

6 Watching her do this and do it well has been surprising

7 He engaged this showed up daily and participated to a larger extent than I anticipated

8 Love her recovery from the first set back, loved watching her figure it all out

9 Fell into a ldrship role as the result of this intervention

10 Supported her teammates abilities w/ the robot by becoming more knowdgble w/ the text

11 Probably engaged it the least b/c she knows few people and keeps to herself but did come almost all of the days

12 Thrived when she was moved into another group

13 Was steadfast thru the whole process and voiced her enthusiasm