NEURODIVERSITY PERSISTENCE IN STEM PROGRAMS: A PHENOMENOLOGICAL STUDY OF SELF-EFFICACY AMONG AUTISTIC STUDENTS IN HIGHER EDUCATION

by

Cecil Anthony Banning

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Philosophy

Liberty University, Lynchburg, VA

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APPROVED BY:

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Abstract

The purpose of this transcendental phenomenological study was to examine the perceptions of self-efficacy among neurodiverse students in STEM programs at four-year universities. Albert Bandara's social cognitive theory (SCT) guided this study as it relates to the influence of environment, social interaction, and communication on learning development and academic mastery. Improving academic self-efficacy among neurodiverse students in STEM programs in higher education begins with understanding how these students encounter the academic world. SCT provided the framework for this study to answer the central research question and sub-questions: (1) What are the self-efficacy experiences of neurodiverse students currently enrolled in a STEM program at four-year institutions in the United States? (2) How do autistic students in STEM-related fields of study experience the social campus environment? (3) How do autistic students in STEM-related fields of study perceive the academic support and accommodations they receive? This study reviewed the background of diversity and inclusion in higher education, research related to the experience of autistic and other neurodiverse students, and the need for a pedagogical approach in STEM programs that accommodates the varied needs of neurodiverse students. The study involved eleven autistic students currently enrolled in STEM-related majors who have completed at least one year of higher education. The research took place at two four-year institutions in the United States: Greenwood University (pseudonym), a state-sponsored institution in the Northeast, and Hightower University (pseudonym), a private research institution in the South. Additional participants were identified through snowball sampling. Data were collected by individual interviews, anecdote discussions, and a focus group. Data analysis followed Moustaka's modification of Van Kaam's method of phenomenological analysis.

Keywords: autism, neurodiversity, self-efficacy, STEM, pedagogy

Dedication

To God, my Heavenly Father, who has used this experience to help me see His creation with new eyes.

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I am more grateful than I can express for the wisdom, encouragement, and patience of those who have ushered me along this journey. Thank you to my Chair, Dr Samora, who has been unrelenting in her confidence in me. You have brought me farther than I believed that I could travel. Thank you, Dr. Eller. Your grasp of the methods of research has opened new doors for me. I am thankful for all that I have learned from you both. Thank you to my wife Michelle for the missed opportunities, the unpredictable schedules, and the late meals that made it possible for me to study and write. Thank you to my mother, Melba, for always being a voice of encouragement and believing, even though no one else in our family has ever walked this path. Thank you to Joe and Claudine, my In-Laws, who saw the completion of this journey from the beginning. Thank you to the Whitehouse Fork Baptist Church family, who gave their pastor time to continue this process. Thank you, Liberty University, for making a place for me. Thank you, Almighty God! Your will be done.

for HIS glory,

Tony Banning

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List of Abbreviations

Associated Press (AP)

Autistic Spectrum Condition (ASC)

Autistic Spectrum Disorder (ASD)

American Medical Association (AMA)

American Psychiatric Association (APA)

Attention deficit hyperactivity disorder (ADHD)

Diagnostic and Statistical Manual of Mental Disorders (DSM)

Identity First Language (IFL)

National Aeronautics and Space Administration (NASA)

National Science Foundation (NSF)

Novel Data Input (NDI)

Person first language (PFL)

Science, math, engineering, and technology (SMET)

Science, technology, engineering, and math (STEM)

CHAPTER ONE: INTRODUCTION

Overview

This chapter aims to introduce the elements which frame the neurodiverse experience of self-efficacy. These elements include the pedagogical approaches common in science, technology, engineering, and math (STEM) programs, the current understanding of neurodiversity from clinical and societal perspectives, and the social and academic supports that can help to bridge the growing gap in neurodiverse persistence in STEM programs. Significantly, each element involves a degree of controversy and conflict within the education environment.

Researchers routinely challenge pedagogical approaches in STEM programs due to the uniquely nuanced nature of STEM studies (Gallagher et al., 2020; Williams et al., 2019; Winberg et al., 2019). Shukla et al. (2019) noted the need for innovative pedagogical approaches that meet the expectations of the changing workplace and the increasingly diverse student population. Sithole (2017) reported that pedagogical deficiencies had hindered persistence despite increasing access to STEM programs globally.

The conflict of neurodiversity begins with its definition. Neurodiversity is a clinical word with a social context. There is a lack of complete agreement on the nature of autism within the medical field and the neurodiverse community (Donachie et al., 2017; Mandy, 2018; Ortiz, 2020; Simmons et al., 2021). Autistic students have reported viewing available academic and social supports as preferential or insensitive, or sometimes both (Bailey et al., 2019; Sarrett, 2017; Simmons et al., 2021). Much research is needed to untangle the knots hindering academic success among students who encounter the intersection of these perspectives. As a beginning place, this researcher will examine how autistic students in STEM-related fields of study perceive their experience of self-efficacy.

This chapter includes a background synopsis that consists of a review of the historical,

social and theoretical contexts of the problem of the perception of self-efficacy among neurodiverse students in STEM programs. Acknowledging the preference of many in the neurodiverse community to recognize autism as a difference rather than a disability, this research employs the term autism spectrum condition (ASC) rather than autism spectrum disorder (ASD). The researcher will also explain the reasoning for using identity-first language (IFL) rather than person-first language (PFL). The researcher's position on the topic is also discussed, including the potential biases of the researcher. The problem and purpose statements describe the research's reasons and the study's aims. The significance of the study is described in terms of the current state of knowledge available and the potential impact of this present research. The research questions are listed, and significant terms related to this study are defined. The chapter concludes with a summary.

Background

In 1947, the Truman Commission on Higher Education called for non-discriminatory access to college campuses. The commission recommended an inclusive approach that identified economic status, race, religious views, gender, and national origin as potential areas of discrimination (United States, 1947). Since then, diversity has become a priority in higher education institutions. In recent days, the terms *diversity* and *inclusion* have taken on broader meaning than the understanding presented by the Truman Commission. Issues of diversity exceed race, gender, and culture. Inclusion aims further than enrollment to the matters of persistence and the realization of academic ambitions. For the neurodiverse population, these changes have great significance. Autistic, dyslexic, attention deficit hyperactivity disorder (ADHD), and other neurodiverse groups experience many challenges in the pursuit of higher education.

Autism is generally described by its symptoms rather than its causes. Social interaction

and communication challenges, restricted interests, and repetitive behaviors characterize it. Autism has been linked to a variety of genetic factors and some environmental influences. Folstein and Rutter (1977) were among the first to examine the genetic origins of autism with their study of autism prevalence in twins. Chess (1971) discovered a link between congenital Rubella and the prevalence of autism due to the way that the disease impacts the nervous system. Several studies have reported a connection between the rate of autism development and the use of Valproate, an antidepressant that was formerly prescribed to pregnant women (Fedrick, 1973; Robert & Guibaud, 1982; Tomson et al., 2016). ASC develops before the age of 30 months and persists throughout the life of the autistic individual (American, 2013). Because autism is a spectrum that encompasses a wide variety of differences and degrees of impact, diagnosis is often delayed until or after late preschool years.

There is a great need for additional research focusing on neurodiversity as a difference rather than a disability. There is also a need to assess research methodologies used to understand neurodiversity. The unique social interaction and communication challenges often associated with neurodiversity can directly influence the willingness of individuals on the autism spectrum to interact with new people and experiences (Curtis-Wendlandt & Reynolds, 2020; Webb & Welsh, 2019). These characteristics hinder researchers from using traditional approaches, such as interviews, to obtain data (Donachie et al., 2017; Haas et al., 2016; Sarrett, 2017).

Historical Context

Terms used to describe the neurodiverse population can affect social and academic inclusiveness. Terminology can have a profound impact on the perception of marginalized groups. Most academic sources recommend person-first language (PFL), that is, an individual with autism rather than an autistic individual. The American Psychiatric Association (APA) and the American Medical Association (AMA) concur with this position (American, 2020;

Gernsbacher, 2017). PFL is a standard reporting style in news reporting as well as research publications to avoid the dehumanizing way people with disabilities have been historically described (Gernsbacher, 2017; Goldstein, 2020). Dunn and Andrews (2015) noted that PFL aims to recognize the entire individual rather than define an individual in terms of their difference and to promote the right of the individual to enjoy complete participation in society.

Autistic advocate John Sinclair (2013) prefers identity-first language (IFL). Sinclair recognizes his autism to be an integral part of his identity. He suggested that PFL contains negative connotations which imply disability. Temple Grandin (2009) employs both forms interchangeably. John Elder Robison (2007), a scholar in residence at William and Mary College, identifies himself as an autistic adult or as an Aspergian. Advocates for IFL note two flaws in the PFL approach. First, PFL designation tends to equate autism with other disabilities. Autistic advocates prefer to describe autism as a difference rather than a disability (Grandin, 2009; Kingsbury et al., 2020; Robison, 2007; Sinclair, 2013; Shattuck et al., 2014). They assert that such language could stigmatize autistic individuals. Secondly, unlike most conditions addressed with PFL, there is no circumstance in which an autistic individual can be separated from his condition (Autism Self Advocacy Network, n. d.; Sinclair, 2013). The aim of IFL is to recognize the entire individual, including his unique giftedness.

Both PFL and IFL are designed to respect the worth and individuality of the referenced person. This researcher does not find fault with either approach. Although IFL is less widely used in scholarly work or publishing than PFL, both the APA publications manual (2020) and the Associated Press (AP) stylebook (Goldstein, 2020) acknowledge either form as acceptable. To acknowledge the preference of many in the neurodiverse community to recognize autism as a difference rather than a disability and to foreground the voices of autistic individuals, this researcher will employ IFL designation for this study. In doing so, I am making no value

judgment regarding either position. To further recognize the wishes of many in the neurodiverse community to distinguish autism as a difference rather than a disability, this researcher will employ the term autism spectrum condition (ASC) rather than autism spectrum disorder (ASD) (Hull et al., 2017; Kingsbury, 2020; Lang & Persico, 2019).

Understanding the self-efficacy experience of autistic students in STEM programs requires understanding the historical development of diagnosis and treatment of autism and the historical development of STEM education. As this research examines the intersection of neurodiversity and pedagogy, it is necessary to situate the study in the context of these evolving historical elements. Each of these developments will be examined more completely in chapter two.

A Brief History of Autism Diagnosis and Treatment

The clinical and social understandings of autism have experienced a nearly constant state of change since it was first identified. The term 'autism' was first employed just over a century ago (Bleuer, 1908) to describe a behavior associated with schizophrenia. Autism as a distinct psychiatric diagnosis first appeared almost eighty years ago (Kanner, 1943). For nearly forty years, autism was classified as a form of childhood schizophrenia (Baker & Lang, 2017; Bettelheim, 1967; Kanner, 1943). The first edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM) described autism as a primary characteristic of childhood schizophrenia (American, 1952). DSM-II (American, 1968) continued this description of autism as a symptom of schizophrenia.

Autism was not formally classified as a condition distinct from schizophrenia until the publication of DSM-III (American, 1980). The period immediately before the reclassification of autism was marked by two crucial developments. First, researchers began investigating the genetic and chemical influences that contributed to ASC (Chess, 1977; Christensen et al., 2013;

Folstein & Rutter, 1977; Robert & Guibaud, 1982). These researchers helped to refute many of the errant ideas regarding the origins of autism. Secondly, autistic individuals like Temple Grandin began to advocate for the needs of autistic individuals (Grandin, 1984; Guglielmo et al., 2018). Her self-advocacy approach from within the neurodiverse community helped autistic students and adults find their voices and define their experiences on their terms.

The discovery of genetic links to autism opened new avenues of investigation. Researchers began linking autism to specific genetic variations (Gillberg & Wahlström, 1985; Payton et al., 1989). This research continues in the present day. DSM-5 (American, 2013) describes autism as a spectrum of conditions that manifest to varying degrees. The current description of autism encompasses five conditions, including Asperger's condition, which had previously been listed as separate conditions (American, 2013; Feinstein, 2010; Riordan, 2013).

Treatment for autism has passed through at least four phases over almost one hundred years, reflecting the prevailing understanding of the condition throughout the decades. The first phase focused on the benefit to society and was motivated by a perception of numerous childhood conditions as permanently debilitating schizophrenia or insanity (Baker & Lang, 2017; Maudsley, 1879). This period was marked by institutionalization and even sterilization. Institutionalism and sterilization were deemed beneficial for society (Baker & Lang, 2017; Holmes, 1927; Wolff, 2004).

The second phase marked a genuine attempt to improve the care and treatment of autistic children. Kanner and Asperger described autism as distinct from schizophrenia (Baker & Lang, 2017; Donavan & Zucker, 2016; Kanner, 1943). A series of novel treatment approaches, including shock therapy, psychoanalysis, and highly restrictive diets, were employed to cure children with autism so that they could lead a more normal life (Bettelheim, 1956; Feinstein, 2010; Kanner, 1973; Wolff, 2004).

The third phase of treatment involved the recognition that autism was a lifelong condition rather than a curable illness. Treatment focuses on helping autistic individuals deal with behaviors and characteristics that hinder their social interaction and integration (Baker & Lang, 2017; Donavan & Zucker, 2016). Most of these treatments involved reinforcement approaches that applied positive and aversive conditioning to reduce the frequency and severity of nontypical behavior (Feinstein, 2010; Gillberg & Wahlström, 1985; Smith & Eikeseth, 2011; Wolff, 2004). Some approaches were designed to help autistic children acclimate to environmental intrusions such as unexpected sounds (Bérard, 1993; Feinstein, 2010).

The most recent phase of treatment and care for autistic individuals arose from a perceptual change within the autism community and in the general public. Many neurodiverse individuals have rejected the concept of autism as a deficit or a disorder (Grandin, 2009; Kingsbury et al., 2020; Robison, 2007). Advocates for neurodiversity focus instead on the distinctive features of the autism experience as a neurological difference and characterize autism not as a neurological or medical disorder but as a distinct and regular expression of the human experience (Kingsbury et al., 2020; Ortiz, 2020; Schreffler et al., 2019; Tomlinson & Newman, 2017). Present-day providers recognize that no single approach meets the needs of all autistic individuals (Lowrey et al., 2017; Moseley & Pulvermüller, 2018; Parish-Morris et al., 2019). Treatment aims to assist the individual in coping with his environment and allow the most possible development of his abilities. These approaches generally focus on creating an environment more inclusive of neurodiverse individuals (Kingsbury et al., 2020; Remy et al., 2014; Unluol Unal et al., 2020; White et al., 2019).

A Brief History of STEM Education

STEM is a hands-on, interdisciplinary approach to teaching four specific disciplines – science, technology, engineering, and mathematics. The modern STEM program traces its roots

to the 1940s when WWII spurred various technological innovations, including transportation, communication, and the atomic bomb (White, 2014). The National Science Foundation (NSF) was formed at the war's end to preserve the scientific and technological advances accomplished during the war effort. In 1958, motivated by the Soviet success with Sputnik, President Eisenhower created the National Aeronautics and Space Administration, NASA (Catterall, 2017; McComas & Burgin, 2020). The birth of the space program led to an acute need for highly qualified engineers and mathematicians. The Apollo moon landings were among the early triumphs of the national STEM programs (White, 2014).

During the 1970s and 1980, many private industries began to partner with the federal government to promote STEM-related initiatives to support an increasing need in the labor market (Gardner, 1983; Penprase, 2020; White, 2014). Cell phones, personal computers, and other consumer-related technology were among the results of these initiatives. Medical advances, improved military weaponry, and advances in space exploration also grew out of the growing STEM fields of education and research (Catterall, 2017; White, 2014).

During the 1990s and 2000s, educational leaders began to work toward standardizing science and engineering classroom guidelines (McComas & Burgin, 2020; White, 2014). The NSF coined the acronym SMET, describing science, mathematics, engineering, and technology (McComas & Burgin, 2020; Mohr-Schroeder, 2015). The acronym was soon changed to STEM. The U.S. National Academies of Science, Engineering, and Medicine announced that students in the United States were dangerously trailing students in other countries in STEM education. Their report called for immediate action to promote and support STEM education to prepare our next generation of labor to compete in a global marketplace. President Bush's *No Child Left Behind (NCLB) Act* (H.R.1, 2001) called for state-level standardized testing to ensure high academic standards in STEM and other educational programs. 2009, President Obama presented the

Educate to Innovate Initiative to increase federal support for STEM and prepare 100,000 new STEM teachers by 2021 (Cavanagh, 2009). Obama's subsequent *Every Student Succeeds Act* mandated provision for the inclusion of arts education in STEM programs to promote a more balanced education approach and to encourage creativity in STEM learning (S.1177, 2016).

Social Context

> The Centers for Disease Control reports that the United States has as many as one in 54 children.

States experience some degree of ASC (Autism, 2020). Many young adults with ASC want to enjoy independence, meet their academic goals, and work in their desired field of employment. Students with a higher sense of self-efficacy demonstrate greater engagement and success in their endeavors and an increased willingness to pursue new challenges (Martin et al., 2017). Autistics interested in science, technology, engineering, and math (STEM) related fields face numerous challenges (Kingsbury et al., 2020; Lang & Persico, 2019; Ortiz, 2020). Much of the neurodiverse experience revolves around communication or perhaps the lack of communication (Simmons, 2021; Tomlinson & Newman, 2017). Often, this difference in communication poses a significant challenge for autistic individuals, which is highlighted by the reality that many neurodiverse individuals struggle in social settings (Jaysane-Darr, 2020).

Autism Spectrum Condition (ASC) has been described as a neurological deficiency, a condition characterized by challenges with social skills, repetitive behaviors, and communication, and a unique condition often marked by enhanced specialization and talent development (Bailey et al., 2019; Donachie et al., 2017; Gillespie-Lynch et al., 2017; Jaysane-Darr, 2020; Kanner, 1943; Sarrett, 2017). Some researchers have suggested that the chief traits of autism are the lack of the ability to infer the minds of others and the inability to empathize (Baron-Cohen et al., 2009; Frith & Happe, 1994). It is probably more accurate to

suggest that autistic individuals process information differently from neurotypical individuals (Kingsbury et al., 2020; Ortiz, 2020). This difference, neurological in nature, results in different social, sensory, and cognitive experiences than those experienced by most individuals. These differences can create significant communication gaps and functional hindrances between the neurodiverse and the world around them.

Because they experience the world differently, autistic students experience various challenges that could hinder academic progress (Accardo, 2019; Brownlow et al., 2015; Lai & Baron-Cohen, 2015; Roberts, 2010; Sarrett, 2017). These challenges are particularly acute during the time of transition from secondary education to higher education, including adapting to academic responsibilities, social and emotional adjustments, housing, and self-advocacy.

Precisely identifying the characteristics of ASC is challenging. Available intellectual scale instruments indicate a broad range of intelligence across the autistic community. Additionally, there is much overlap between neurodiverse and neurotypical intellectual ranges (Mandy, 2018; Ortiz, 2020; Tomlinson & Newman, 2017). Verbal ranges offer similar diversity. While social interaction is a crucial distinguishing feature of the diagnosis of autism, studies also indicate that social withdrawal is not consistent across the spectrum, nor is this characteristic limited to the neurodiverse community (Bailey et al., 2019; Lai & Baron-Cohen, 2015). Identification is also challenged by the reality that many individuals with ASC might develop coping strategies to conceal recognizable behaviors in social interaction (Hull et al., 2017; Kingsbury et al., 2020). These strategies, called masking, include mimicking the behavior of others in the social group or practicing eye contact.

Theoretical Context

Albert Bandura's social cognitive theory (1986) is based on the reciprocal interactions

between behavioral, environmental, and personal variables. Bandura asserts that a large portion of learning occurs in a social context. Bandura (1977) described modeling as the primary instrument for teaching and self-efficacy as the primary motivation for learning. Many skills and cognitive mechanisms are developed through interaction, observation, imitation, and refinement (Bandura, 1986). Martin, Burns, and Collie (2017) noted that the association between self-efficacy and academic success is stronger for neurodiverse students than for neurotypical students. This is especially significant in the study of neurodiversity since many autistics face challenges with socially acquired cognition and the development and refinement of social skills (Bailey et al., 2019; Donachie et al., 2017; Ortiz, 2020). There is much evidence that autistic individuals do not learn in the way subjects are traditionally taught (Kingsbury et al., 2020; Ortiz, 2020). Because social learning involves a cyclical learning process through imitation, the learning process can be disrupted if specific abilities, such as the tendency to imitate, are absent. Some autism traits could manifest due to inadequate functioning of the social learning cycle rather than dysfunction of brain mechanisms (Howe & Stagg, 2016). Researchers suggest that universal design for learning (UDL) may significantly impact academic success (Chiang, 2020; Donachie et al., 2017; Schreffler et al., 2019). UDL is an education approach based on an architectural concept of equal access to buildings and roadways without requiring extensive, specialized accommodations. The pedagogical approach is based on the seven principles of the original architectural concept: equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use (Rappolt-Schlichtmann et al., 2018). In education, UDL focuses on pedagogy, performance evaluation, and student engagement (Capp, 2017; Sarrett, 2017; Seok, 2018). UDL aims not to create accommodations for each unique category of needs but to structure pedagogy and accommodation to meet individual needs while ensuring that the curriculum is accessible to

all students (Capp, 2017; Freund, 2020). These accommodations should include considerations for interaction, knowledge acquisition, and technology use.

Neurodiverse individuals may also encounter difficulties with social learning due to confusing reinforcements. Reinforcement conditions the individual to maintain or discard specific learning or behavior (Bandura, 1986). For a neurotypical individual, the internal portion of reinforcement may be the sense of satisfaction derived from the mastery of social skills. For neurodiverse individuals, this mastery may come at a far greater cost and only serves to remind the individual that the next accomplishment will demand just as much effort (Ortiz, 2020). This can dissuade autistic individuals from adapting to a cultural norm that is already complex and somewhat alien to them (Grandin, 2009).

Astin (1999), through his theory of student involvement, suggests that the amount of physical and psychological energy a student invests in his academic experience will directly impact his persistence. Astin explained that the degree to which a student is involved with studies, extracurricular activities, interaction with faculty and peers, and campus-connected organizations can strongly indicate a student's prospects for academic success. Bandura (1977) asserted that self-efficacy determines the degree and duration of a student's investment toward an educational goal. Without that investment, social cognitive development will be significantly limited.

Problem Statement

The problem is that many neurodiverse students in higher education STEM programs struggle to persist to graduation (Accardo et al., 2019; Bailey et al., 2019; Ehsan et al., 2018; Ortiz, 2020; Rappolt-Schlichtmann et al., 2018).

Bandura (2019) noted that there is little opportunity for cognitive development without appropriate resources and environmental support to facilitate that development. The most commonly reported supports for autistic students are longer testing times and flexible schedules (Brown & Coomes, 2016; Sarrett, 2017). While helpful to many students, these supports are not well suited to autistic students for at least two reasons. First, these supports arise from a deficit mindset (Kingsbury et al., 2020; Ortiz, 2020). Such supports are provided to accommodate students who cannot meet the typical standards of academic life. These accommodations ensure more equitable access to educational content (Bailey et al., 2019; Brown & Coomes, 2016; Sarrett, 2017). This goal misses the need for autistic students who acquire and demonstrate knowledge mastery differently than neurotypical students (Moseley & Pulvermüller, 2018; Shattuck et al., 2014; Tomlinson & Newman, 2017). Secondly, the accommodations may be counterproductive for neurodiverse students. Flexible scheduling, for example, may present a conflict for an autistic student who relies on fixed scheduling as part of his coping mechanisms for dealing with the academic environment (Haas et al., 2016; Sarrett, 2017). Donachie et al. (2017) pointed out that autistic students more commonly seek support to improve social interaction. Autistic individuals often struggle with social interaction or direct communication (Bailey et al., 2019; Donachie et al., 2017; Ortiz, 2020). As communication and social interaction are vital functions of education, these realities create unique challenges for autistic students in higher education (Hull et al., 2017). Bandura (2011) noted that social interaction is a crucial function of cognitive development, beginning with an individual's first social group: families and early friendships.

More research is needed on the relationship between pedagogical approaches and the self-efficacy of neurodiverse students. There is even less literature that examines the perceptions of neurodiverse students themselves (Judge, 2018; Sarrett, 2017). Additionally, autistic students

are often hypersensitive to environmental factors such as light, sound, or space in the classroom or lab settings. These experiences can create distraction and anxiety, hindering academic performance and social integration (Grandin, 2009; Haas et al., 2016). This study will help give voice to the perception of those most impacted by these challenges to better inform changes and adaptation in pedagogy and environment.

Purpose Statement

This transcendental phenomenological study will describe the self-efficacy experiences of neurodiverse students currently enrolled in a STEM program at four-year institutions in the United States. This study will be guided by Albert Bandura's social cognitive learning theory (1986) as it explores the social and communicative elements of learning—two challenging perspectives for neurodiverse students. Data will be collected through open-question interviews, artifact discussions, and a follow-up focus group discussion. Self-efficacy is the confidence to complete an assigned task or attain a desired goal (Bandura, 1977).

Significance of the Study

The participants of this study will describe their unique experiences as autistic students navigating STEM classes. The findings of this study will be significant because they could provide a greater understanding of the challenges and needs that impact persistence in the academic setting.

Theoretical Significance

This study is guided by Bandura's (1986) social cognitive theory (SCT). This theory examines the impact of social modeling on cognitive development. Researchers have noted that modeling is ineffective in raising self-efficacy unless the student recognizes a relational similarity between himself and the model—a social or competency connection between student and teacher (Bandura, 1977; Channaoui et al., 2020; Martin et al., 2017). Self-efficacy, a pivotal

component of SCT, motivates the learning and attainment processes of the student (Bandura, 1977; Bushwick, 2001). According to Bandura (1986), social integration, communication efficacy, and environmental acclimation are essential to cognitive progress. Neurodiverse students often struggle with one or more of these elements (Bailey et al., 2019; Donachie et al., 2017; Ortiz, 2020). This study will contribute to understanding the importance of effective social modeling in self-efficacy experiences.

Empirical Significance

This research study aimed to address gaps in the literature at crucial junctures of pedagogy and autistic development. This study approached the self-efficacy question at two critical intersections. First, self-efficacy is examined in light of the unique experiences of autistic students in higher education (Caruna et al., 2019; Cooper et al., 2017; Grandin, 2009). This perspective foregrounds the lived experiences of autistic students in the academic setting and within their community of support. This study is predicated on the idea that no one can understand the autistic experience better than those who live it every day and that any successful descriptive communication of that experience must be from the perspective of those individuals and their communities (Den Houting, 2019; Donachie et al., 2017; Grandin, 2009; Ortiz, 2020). Secondly, self-efficacy is examined as a product of pedagogical approaches and social environment (Chiang, 2020; Lowrey et al., 2017). This perspective gives special attention to the customary pedagogical approaches within higher education STEM programs, the foundations and justifications of those approaches, and the challenges that must be overcome to improve those approaches.

Practical Significance

Understanding the unique experiences of autistic students can have lasting impacts on

pedagogical supports and approaches (Accardo et al., 2019; Courchesne, 2019; Donachie et al., 2017; Freund, 2020). Altering pedagogical and social paradigms could dramatically improve persistence through intentional inclusion and environmental accommodations (Bailey et al., 2019; Felege et al., 2018; Moseley & Pulvermüller, 2018). Reexamining standard practices could uncover hindrances to academic success (Alper, 2018; Brownlow et al., 2015; Gillespie-Lynch et al., 2017; Lang & Persico, 2019;). For example, classroom practices such as asking questions during a lecture or using large lecture halls, for example, may disadvantage students who tend to avoid attracting attention in class due to social anxiety (Jaysane-Darr, 2020; Judge, 2018). While this research does not examine the impact of pedagogical reform on departments or faculty, these impacts should also be considered to ensure valuable results.

Research Questions

The perception of self-efficacy is essential to social learning (Bandura, 1977; 1997b). Cognitive development and learning are influenced by social integration, communication efficacy, and environmental acclimation (Bandura, 1986). Because autistic students may struggle with these learning skills, traditional classroom environments, and pedagogical approaches do not always support their academic needs.

Central Research Question

What are the self-efficacy experiences of neurodiverse students currently enrolled in a STEM program at four-year institutions in the United States?

Sub-Question One

How do autistic students in STEM-related fields of study experience the social campus environment?

Sub-Question Two

How do autistic students in STEM related fields of study perceive the academic supports and accommodations which they receive?

Definitions

1. *Autism Spectrum Condition (ASC)*—a designation preferred by autistic individuals because it recognizes that autism diagnosis encompasses a broad range of characteristics because the designation indicates a difference rather than a deficiency (Accardo et al., 2019; Bailey et al., 2019).
2. *Neurodiversity*— a range of variations in brain function and social interaction that is primarily associated with autism, but also encompasses ADHD, dyslexia, dyspraxia, and Tourette syndrome (Kingsbury et al., 2020)
3. *Novel Data Input*—the autistic experience of hyper-awareness and dynamic memory, which often reduces every new environment to data that is immediately collected and stored in the autistic mind
3. *STEM*—a hands-on, interdisciplinary approach to teaching four specific disciplines – science, technology, engineering, and mathematics (McComas & Burgin, 2020; Mohr-Schroeder, 2015).
4. *Universal Design for Learning (UDL)*—an education approach based on an architectural concept of equal access to buildings and roadways without requiring extensive, specialized accommodations (Capp, 2017; Seok et al., 2018).

Summary

Self-efficacy is an essential motivation for success in any endeavor (Bandura, 1977; Bushwick, 2001; Martin, 2017). Internal factors such as self-identity and external factors such as social integration influence self-efficacy (Bandura, 1977; 1997b). The history of diagnosis and treatment of autism reflects a continuous state of change and revision (Baker & Lang, 2017;

Finestein, 2010; Wolff, 2004). Autism has yet to be universally defined, and no approach to treatment or accommodation universally benefits the ASC community (American, 2013; Baron-Cohen et al., 2009; Donachie, 2017). Legislation promoting inclusion generally addresses gender, race, or disability, with little attention given to neurodiversity (Cavanagh, 2009; Gardner, 1983; H.R.1, 2001; S.1177, 2016). Despite the growing public recognition of autism as a difference rather than a deficit, governing organizations, legislation, and psychiatric professionals continue to address autism solely as a disorder or disability (American, 2013; Cavanagh, 2009; Gardner, 1983; H.R.1, 2001; S.1177, 2016). This approach has fostered a severe condition of identity confusion among many autistic individuals (Accardo, 2019; Brownlow et al., 2015; Lai & Baron-Cohen, 2015; Ortiz, 2020; Sarrett, 2017; Tomlinson & Newman, 2017). This experience of stereotype threat can seriously harm self-efficacy.

The higher education environment can be challenging for any student. The social and communication demands are even more significant for the neurodiverse (Donachie, 2017; Haas et al., 2016; Kingsbury et al., 2020; Tomlinson & Newman, 2017). Content-driven STEM programs tend to offer accommodations that are aimed at improving access to content rather than recognizing that neurodiverse students tend to learn and express knowledge differently (Accardo et al., 2019; Alper, 2018; Brown & Coomes, 2016; Donachie et al., 2019 Sarrett, 2017). Like federal legislation, accommodations in STEM are most commonly oriented toward recognizing autism as a disability (Gillespie et al., 2017; Haas, 2016; Jaysane-Darr, 2020; Penprase, 2020; Roberts, 2010; White, 2014). The neurodiverse community, however, will not necessarily benefit from these accommodations because their need relates to how teaching is approached more than access to content (Jaysane-Darr, 2020; Kingsbury et al., 2020; Ortiz, 2020). It is difficult for neurotypical individuals to understand and interpret the experiences and actions of neurodiverse individuals and groups (Donachie, 2017; Haas et al., 2016; Kingsbury et al., 2020; Tomlinson &

Newman, 2017). Understanding the pedagogical and support needs of autistic students requires a participatory approach that foregrounds the voices of the autistic students.

CHAPTER TWO: LITERATURE REVIEW

Overview

Neurodiverse students experience the world differently. Their experiences differ from neurotypical individuals and each other. Understanding the academic experience among neurodiverse students begins with understanding how these students encounter the academic world and also includes an examination of accepted teaching and assessment approaches. This literature review examines research related to the experience of autistic and other neurodiverse students, the benefits of universal design for learning (UDL), and the need for a pedagogical approach in STEM programs that accommodates the specific and varied needs of neurodiverse students. UDL, initially developed for elementary and secondary education, is not widely used in STEM programs. This chapter presents the theoretical framework for the research. Additionally, related literature is reviewed. This includes an examination of literature related to the study of autism, the concepts of universal design for learning, and the pedagogical and social challenges autistic students face in social learning environments. The chapter concludes with a summary.

Theoretical Framework

A theoretical framework provides a rationale for research and justifies the research results (Gall et al., 2007). Bandura's (1986) social cognitive theory (SCT) proposes that learning and social understanding can be acquired by observing and imitating others. Bandura was influenced by Miller and Dollard's *Social Learning and Imitation* (1941). Miller and Dollard asserted that humans are born without rules for processing information. Information is gathered through sensory input and experience (Miller & Dollard, 1941; Schunk & DiBenedetto, 2020; Smith & Hitt, 2005). Their learning theory describes four processes that influence development: drive, cue, response, and reinforcement. Drives are the innate urges that humans are naturally motivated to satisfy. Cues are any signals which might suggest an opportunity to satisfy a drive.

As unsatisfied urges produce discomfort, humans respond to the cues. If the response tends to satisfy a drive, the individual's choice to respond is reinforced. As individuals become more successful at satisfying drives, they are more likely to respond to cues and consider new cues a possible satisfaction for other drives. The theory is dependent on assumptions of classical and operant conditioning (Bandura, 2006; Miller & Dollard, 1941; Schunk & DiBenedetto, 2020). Bandura found behaviorism an inadequate theory because it generally asserted that learning was a response to stimuli (Bandura, 2006).

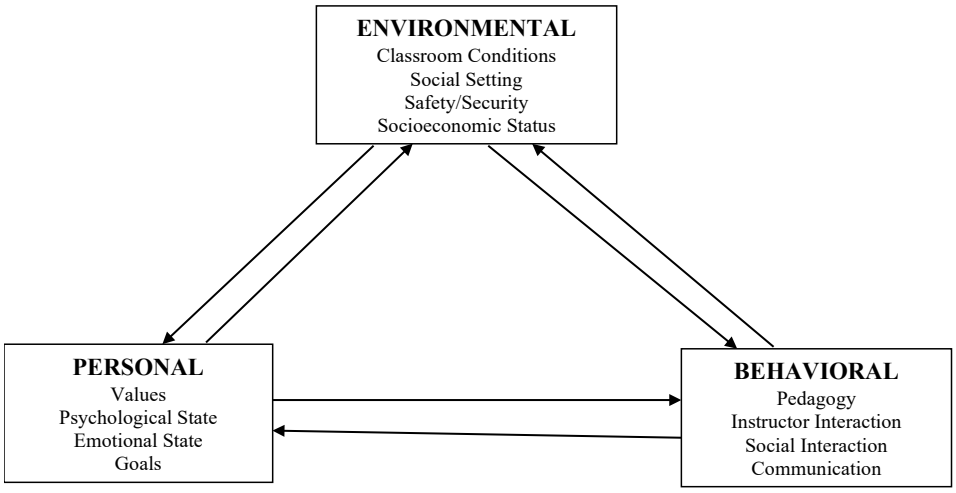
The Distinctives of Social Cognitive Theory

For Bandura, a significant component of Miller and Dollard's theory was that learning was a social experience usually associated with imitating the representative behavior of others (Bandura, 2006). Departing from behavioral learning theories, however, he contributed at least three significant developments in completing his thesis. First, according to Bandura, learning is a cognitive rather than a conditioning process (Schunk, 2019). Behaviorism suggests that learning is a process of imitation, repetition, and reinforcement, which could be accomplished without emphasis on mental processes. Bandura (1986) described learning as a cognitive process rather than behavioral conditioning. Bandura's social cognitive theory (1986) is based on the reciprocal interactions between behavioral, environmental, and personal variables (Figure 1). This interaction, also described as reciprocal determinism, depicts the interdependence of these three determinants on the cognitive development process (Bandura, 1986; 1997). Bandura asserted that a large portion of learning occurs in a social context. The cognitive process mediates cues and responses (Bandura, 1986; 2006; Driscoll & Modi, 2020). Secondly, Bandura (1982; 1986) noted that a great deal of learning is vicarious—that the student can cognitively grasp information and draw conclusions about a concept by observing others performing tasks or explaining ideas without directly participating in the experience (Bandura, 1986; Driscoll & Modi, 2020; Smith &

Hitt, 2005). SCT stresses the importance of this modeling process as an essential characteristic of learning. The idea of modeling is vital to Bandura's theory. Modeling is demonstrating or explaining cognitive and behavioral skills (Bandura, 1977; Schunk, 2019). This idea differs from behaviorists' concepts of imitation in that the impact of the modeling is first cognitive.

Figure 1

Bandura's Triad of Reciprocal Interaction



Finally, SCT is an agentic theory in which people generally perceive themselves as agents exercising control over their lives. SCT depicts the response to stimuli as cognitive, with the individual acting with the agency to determine his course of action or inaction with regard to the stimuli (Bandura, 1977; 1986; 2006). Learning is influenced by personal motivation. Agentic control describes choosing a course of action or persisting in that course based on a subjective perception of one's beliefs and abilities (Bandura, 1986; Pajares, 1996). The distinctives of cognitive development, vicarious learning, and agentic involvement are the unique features of SCT (Bandura, 1986; Schunk, 2019).

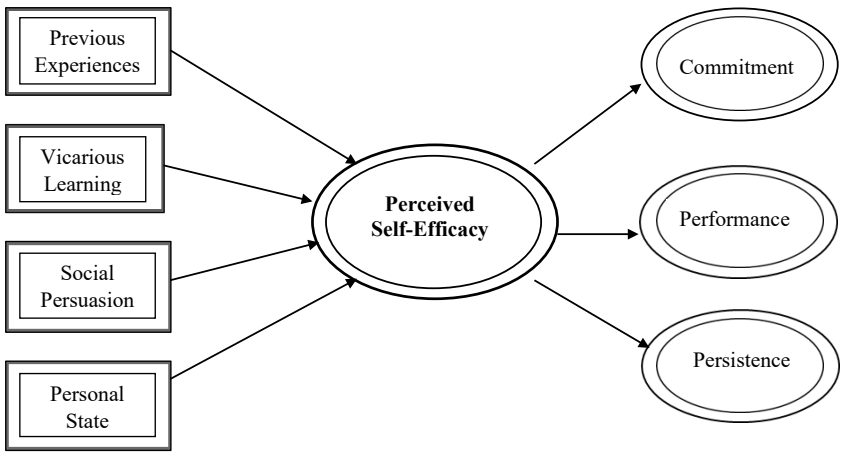
Self-Efficacy and Social Learning

Self-efficacy is belief about one's ability to accomplish a task. This is a critical variable

in SCT because self-efficacy is the motivating mediator between knowledge and action (Bandura, 1977; Pajares, 1996). Because SCT is an agentic theory, internal motivation is critical to learning success. The degree to which students benefit from social learning environments (classroom, group study, etc.) directly impacts self-efficacy (Bandura, 1982; 1986b). Schaeffer (1976. p. 19) observed, "People have presuppositions, and they will live more consistently based on these presuppositions than even they may realize." Self-efficacy can be described as a presupposition that someone has about themselves. SCT proposes that personal agency directly impacts an individual's motivation and likelihood of success (Bandura, 1986). Bandura (1997) noted that self-efficacy derives from previous experiences, vicarious modeled experiences, social persuasion, and one's emotional and psychological state (Figure 2). This is especially significant in the study of neurodiversity since many autistics face challenges with socially acquired cognition and the development and refinement of social skills (Accardo, 2019; Brownlow et al., 2015; Lai & Baron-Cohen, 2015; Sarrett, 2017).

Figure 2

Influences and Outcomes of Self-Efficacy



SCT is based on the reciprocal interactions between behavioral, environmental, and personal variables (Bandura, 1986). This triadic reciprocity represents the impact of these three

interdependent variables on the learning outcome. Bandura (1977; 1986) asserts that much learning occurs in a social context. Many skills and cognitive mechanisms are developed through interaction, observation, imitation, and refinement (Bandura, 1977b; 1986; 1988). Development is reinforced through positive and negative rewards. The reinforcement may be external or internal. As seen in *Figure 2*, the four critical influences of perceived self-efficacy directly impact the individual's choice to commit to a course of action, the likelihood of success, and the likelihood of persisting in that action.

Theoretical Framework of Research

There is a lack of research regarding the applicability of SCT to autistic students. This research examines the self-efficacy perceptions of autistic students in a social learning environment. The three elements of Bandura's triad (*Figure 1*) are the foundation of the research questions. The personal, behavioral, and environmental influences that impact the autistic student on the university campus all directly influence the student's self-efficacy. Because a large portion of learning occurs in a social context (Bandura, 1977; 1986), the data collection methods will emphasize the social experiences of the participants. Social interactions will be examined subjectively through specific interview questions and directly through focus group exchanges. This theory also influences analysis processes, emphasizing modeling and the social context of learning. The research will focus on the agency experiences of the students concerning the four primary influences of self-efficacy as described by Bandura (1977) and how those influences intersect the reciprocal triadic elements of SCT (Bandura, 1986). This research will contribute to a fuller understanding of the relevance of SCT to the social challenges and unique information-processing approaches of autistic students. Additionally, this research will highlight the relationship between self-efficacy theory and the pedagogical environment of STEM programs in higher education.

Related Literature

Neurodiversity and universal design for learning (UDL) are relatively new study topics. The available research indicates a need to connect the benefits of UDL with pedagogy reforms that foreground autistic students' needs. The literature related to the nature and needs of neurodiversity reflects some of the personal influences experienced by the neurodiverse community. Research associated with UDL describes some of the environmental influences. The study of pedagogy reveals behavioral influences that impact students. Each of these areas validates the reciprocal nature of Bandura's (1986) triad.

Toward Understanding Neurodiversity

In 1943, noted psychiatrist Leo Kanner published his research findings on children with distinct social interactions. Using the Greek word for *self*, Kanner identified their condition as Autism or absorption with self (Kanner, 1943). In describing the children's condition, he equated their affective disability with physical and intellectual handicaps (Kanner, 1943). Kanner was not confident that the children could hope to progress significantly due to this condition. When Kanner was pursuing his research, a math genius named Alan Turing was deciphering the German enigma code and developing a mathematical process that would eventually evolve into the modern computing theory. Although he was never tested, O'Connell and Fitzgerald (2003) reported that Turing exhibited all of the characteristics associated with Asperger's Syndrome. Neurodiversity embraces a wide range of neurological conditions which tend to impact interaction with one's environment. Numerous attempts have been made to define the condition, but no consensus exists.

The Nature of Neurodiversity

The term autism was coined by psychiatrist Eugen Bleuler in 1908. He developed the term to describe the mental processes of several patients under his care, which he described as

schizophrenic—also a term that he created (Bleuler, 1908). He used *autism* to distinguish internalized thinking from reality-based thinking, which considers the surrounding environment and other people's thoughts (Bleuler, 1908). Although this description does not apply to the behavior observed by Kanner, Bleuler was likely Kanner's source for the term (Bettelheim, 1967; Feinstein, 2010).

In his description of the children that he observed, Kanner (1943) noted several distinct characteristics that the children shared in varying degrees, including an extreme mental and emotional separation from others and their immediate environment, speech abnormalities, including the inability to use language for communication, repetitive behaviors, and a need for their environment to remain unchanged (Kanner, 1943). Kanner observed that the children were characterized by an "extreme autistic aloneness" (Kanner, 1943. p. 242) and that they displayed a preference for objects over human beings. Although he suspected that the condition was congenital, Kanner noted that the parents of the children were knowledgeable, inclined toward scientific or artistic pursuits, and generally uninterested in social relationships with other people (Kanner, 1943). He speculated that the parents' aloofness could have impacted the social development of the children (Baker & Lang, 2017; Kanner, 1943; Wolff, 2004).

Hans Asperger was a Viennese pediatrician and a contemporary of Kanner. In 1944, he described several cases of children whose behavior was marked by limited social and emotional development (Baker & Lang, 2017; Donavan & Zucker, 2016; Wolff, 2004). He noted that they exhibited remarkable abilities in mathematics and the sciences. He also described the unique modes of thinking demonstrated by the children. Like Kanner, Asperger described the children's behavior as autistic. He suggested that the condition was a personality disorder with organic causes (Feinstein, 2010). Although a contemporary of Kanner, Asperger's work was less

systematic. He used the term autism in lectures as early as 1938, but his work was not widely received until decades later (Baker & Lang, 2017; Feinstein, 2010).

Bruno Bettelheim (1956) was adamant that autism was sociological in origin. He maintained that autism was a psychological defensive reaction triggered by maternal ambivalence. He affirmed Kanner's (1943; 1973) observation that many of the children he observed appeared to have cold and indifferent parents. The idea of autism as a stress-induced reaction to environmental factors was so well received that it garnered a Nobel Prize for medicine for one of its proponents (Vicedo, 2018). Rimland (1964) posed the earliest challenge to a sociological cause for autism, suggesting a hereditary origin instead.

The 1970s were a period of great development in autism research. Two significant research developments were the progress in the study of hereditary genetics and research into environmental factors that can influence the development of autism. Folstein and Rutter (1977) examined the incidence of autistic characteristics in twins. Their study demonstrated a hereditary connection to autism and was the foundation for the disproval of the refrigerator mother theory (Feinstein, 2010; Folstein & Rutter, 1977; Rutter, 1968).

During the 1970s, researchers began to publish findings regarding environmental influences on neural development. Stella Chess (1971) examined 243 children who had contracted the rubella virus. Using Kanner’s guidelines for diagnosis, she reported a high prevalence of autism. Valproic acid and other antiseizure medications were scrutinized (Christensen et al., 2013; Fredrick, 1973; Tomson et al., 2016). Robert and Guibaud (1982) determined that valproic acid was teratogenic—prone to producing congenital disabilities when taken during pregnancy. These researchers noted specific neural deformities attributed to this drug (Christensen et al., 2013; Robert & Guibaud, 1982).

Another significant development in the 1970s profoundly redirected the course of autism research. An autistic high school student named Temple Grandin built a device known as a squeeze machine or a hug box. Grandin had an aversion to being touched by other people and had unpleasant memories of experiencing hug therapy as a child (Almanza, 2016; Grandin, 1984; Grandin & Scariano, 1996). Her device provided deep pressure, which helped to calm her hypersensitivity without the undue stress of being touched by others (Grandin, 1984). An additional benefit of her device was that the person being squeezed had complete control over the extent and duration of the pressure. In the years to follow, Grandin became an advocate for the needs of autistic individuals (Almanza, 2016; Grandin, 1984; Guglielmo et al., 2018). Grandin's device, advocacy, and writings changed autism research in at least three ways. First, her work was from the perspective of a layperson rather than a medical professional or a skilled behavioralist. Her thoughts were more accessible to the general public. Secondly, she focused on discovering the needs of those in the autistic community rather than trying to discover ways to cure or normalize them. Finally, her work helped to launch self-advocacy in the neurodiverse community. She demonstrated that the neurodiverse community had a voice and could articulate its needs.

Radical changes in the conceptualization of autism marked the 1980s and the following decades. The idea of autism as a hereditary condition opened new avenues of genetic investigation. Researchers began to specifically link autism to congenital abnormalities (Gillberg & Wahlström, 1985; Payton et al., 1989). The Genome Project, an ambitious undertaking to map the human genetic code, added to the pursuit (Mendelsohn, 1987). The Genome Project fostered hopes of discovering an autism gene or a specific deviation that could be identified as the source of autism (Cook-Deegan, 1994; Payton et al., 1985). Instead, genetic researchers discovered no single genetic etiology for autism. Instead, researchers have noted that autism is heterogenous in

its pathology, its manifestation, and its management (Hodges et al., 2019; Lowrey et al., 2017; Moseley & Pulvermüller, 2018; Parish-Morris et al., 2019). Dr. Lorna Wing coined the term Asperger's syndrome and introduced the idea of autism as a spectrum of conditions and degrees of intensity (Feinstein, 2010). These concepts were reflected in DSM-IV (American, 1987).

Treatment for autism passed through at least four stages throughout almost one hundred years as it followed the prevailing understanding of the condition throughout the decades. The first stage focused on the benefit to society and was motivated by a perception of numerous childhood conditions as permanently debilitating schizophrenia or insanity (Baker & Lang, 2017; Maulsey, 1879). This period was marked by institutionalization and even sterilization. The eugenics movement promoted these approaches early in the twentieth century (Baker & Lang, 2017). The eugenics movement envisioned improving the human race by removing inferior strains. Eugenic sterilization for societal benefit found support in the Supreme Court of the United States when Justice Oliver Wendell Holmes Jr. noted that "three generations of imbeciles are enough" (Holmes, 1927). Institutionalism and sterilization were deemed beneficial for society (Baker & Lang, 2017; Holmes, 1927; Wolff, 2004).

The second stage marked a genuine attempt to improve the care and treatment of autistic children. As the popularity of the eugenics movement experienced a sharp decline, mainly due to the actions of Adolf Hitler, researchers like Kanner and Asperger began describing autism as a condition distinct from schizophrenia (Baker & Lang, 2017; Donavan & Zucker, 2016; Kanner, 1943). Long-term institutionalization was among the earliest treatments for autistic children who were regarded by the medical community as schizophrenic. Kanner (1973) believed this approach was ineffective as a treatment and essentially eliminated any hope for real improvement. Electric shock therapy and highly restrictive diets were also among the first therapies for autism (Feinstein, 2010). In the 1950s and 1960s, the primary therapeutic approach

to autism was psychoanalysis. Building on the theory popularized by Kanner and Bettelheim (Bettelheim, 1956; Kanner, 1973) that autism was a social disorder caused by frigid parenting, therapists focused their efforts on discovering and correcting defective parental behavior through psychoanalysis (Feinstein, 2010; Wolff, 2004). These treatment approaches were intended to cure autism and allow the patient to live normally.

The third stage of treatment involved the recognition that autism was a lifelong condition rather than a curable illness. Treatment focused on helping the autistic individual deal with behaviors and characteristics that hindered their social interaction and integration (Baker & Lang, 2017; Donavan & Zucker, 2016). With the recognition of the genetic origins of autism, therapists in the 1970s abandoned the practices of institutionalization and psychoanalysis, turning instead to approaches designed to help control the symptomatic behaviors of autism (Gillberg & Wahlström, 1985; Wolff, 2004). The most prominent approaches were punitive shock therapy and holding therapy. Punitive shock therapy involved administering a painful electric shock when the patient exhibited an unwanted behavior such as repetitive movement or echolalia (Feinstein, 2010; Wolff, 2004). The goal was to reduce the frequency of that behavior through aversive conditioning. Holding therapy or hug therapy involved physically restraining the autistic child and forcing eye contact for extended periods (Feinstein, 2010; Gillberg & Wahlström, 1985; Wolff, 2004). The physical restraint and eye contact were believed to facilitate rebonding between the parent and child. Both were conditioning therapies based on a behaviorist perspective of learning that negative and positive reinforcement would condition the subject to produce the desired response.

Guy Bérard, a French physician, developed auditory integration training (AIT) in the 1970s (Bérard, 1993; Feinstein, 2010). The treatment involves regularly exposing the individual to differing sounds for brief periods. The goals are to acclimate the patient to sound intrusion and

to help train the auditory receptors to receive and interpret the sounds more normally (Bérard, 1993; Lehrman, 2007). This treatment has demonstrated success in many cases and is still currently employed. Applied behavioral analysis (ABA) was another prominent treatment approach developed during this time. Ivar Lovass pioneered ABA, focusing on intensive therapy, parental involvement, and early intervention (Smith & Eikeseth, 2011). His therapy was based on modeling, mimicry, and reinforcement to help autistic children interact more naturally in the social environment (Feinstine, 2010; Smith & Eikeseth, 2011). Some pharmaceutical treatments have been successful in moderating some of the behavioral symptoms of ASC, including anxiety and irritability. Pharmaceuticals are also used with ABA (Feinstine, 2010; Smith & Eikeseth, 2011).

The most recent phase of treatment and care for autistic individuals arose from a perceptual change within the autism community and in the general public. Many neurodiverse individuals have rejected the concept of autism as a deficit or a disorder (Grandin, 2009; Kingsbury et al., 2020; Robison, 2007). Advocates for neurodiversity focus instead on the distinctive features of the autism experience as a neurological difference and characterize autism not as a neurological or medical disorder but as a distinct and normal expression of the human experience (Kingsbury et al., 2020; Ortiz, 2020; Schreffler et al., 2019; Tomlinson & Newman, 2017). Present-day providers recognize that no single approach meets the needs of all autistic individuals (Lowrey et al., 2017; Moseley & Pulvermüller, 2018; Parish-Morris et al., 2019). Treatment aims to assist the individual in coping with his environment and to allow the most total possible development of his abilities. These approaches generally focus on creating an environment more inclusive of neurodiverse individuals (Kingsbury et al., 2020; Remy et al., 2014; Unluol Unal et al., 2020; White et al., 2019).

Arriving at a definition of the ASC is no small task. Geneticists note that "autistic disorder is likely not a distinct, categorical disorder but instead represents one extreme of a spectrum of social and communication impairment and behavioral restriction. (Veenstra-Vanderweele et al., 2004. p. 380)." Autism is commonly described as a heterogeneous neuropsychiatric disorder—a condition that encompasses a wide range of symptoms that are not uniformly present. Clinical diagnosis may be challenging and often disputed. The condition is described as a spectrum because the diagnosis covers a variety of characteristics that may or may not all be present in any individual (Donachie et al., 2017; Gillespie-Lynch et al., 2017; Veenstra-Vanderweele et al., 2004). There is little agreement regarding the cause of autism. Proponents of a genetic source acknowledge that no singular genetic deviation or collection of deviations causes the condition (Lowrey et al., 2017; Moseley & Pulvermüller, 2018). It appears that many possible genetic variations could result in the same condition. There is an intense debate over whether environmental factors influence the prevalence of autism. Further complicating the description of the condition, the currently accepted diagnosis of ASC encompasses five conditions formerly described separately in DSM-IV (Chen et al., 2020; Hodges et al., 2019).

ASC has been described as a neurological deficiency, a condition characterized by challenges with social skills, repetitive behaviors, and communication, and a unique disability often marked by enhanced specialization and unique talent development (Bailey et al., 2019; Donachie et al., 2017; Gillespie-Lynch et al., 2017; Jaysane-Darr, 2020; Kanner, 1943; Sarrett, 2017). It is more accurate to suggest that autistic individuals process information differently from neurotypical individuals (Kingsbury et al., 2020; Ortiz, 2020). This difference, neurological in nature, results in different social, sensory, and cognitive experiences than those experienced by most individuals (Howe & Stagg, 2016; Kingsbury et al., 2020; Ortiz, 2020). These differences

can create significant communication gaps and functional hindrances between the neurodiverse and the world around them (Brignell et al., 2018; Sarrett, 2017; Tomlinson & Newman, 2017). The social challenges posed by ASC seem to hinder the typical development of language and communication skills among children with ASC. Non-verbal expression and imitation are valuable predictors of language development among children with ASC (Howe & Stagg, 2016; Sarrett, 2017; Tomlinson & Newman, 2017). Joint attention skills and the ability to recognize and respond to social cues from others may also predict language development (Parish-Morris et al., 2019). Joint attention is an essential skill for communication development among children with or without ASC (Caruana et al., 2018).

Specifically, identifying the characteristics of ASC is challenging. Available intellectual scale instruments indicate a broad range of intelligence across the autistic community (Brignell et al., 2018). Additionally, there is much overlap between neurodiverse and neurotypical intellectual ranges. Verbal ranges offer similar diversity (Moseley & Pulvermüller, 2018). Although social interaction is a crucial distinguishing feature of the diagnosis of autism, studies also indicate that social withdrawal is not consistent across the spectrum, nor is this characteristic limited to the neurodiverse community (Bailey et al., 2019; Hull et al., 2017; Lai & Baron-Cohen, 2015). Identification is also challenged by the reality that many individuals with ASC might develop coping strategies to conceal recognizable behaviors in social interaction (Hull et al., 2017). These might include mimicking the behavior of others in the social group or practicing eye contact. Anderson et al. (2020) suggest that autistic females are diagnosed at a lower rate than males because females are more capable of developing masking techniques that conceal the characteristic traits of ASC.

Because they experience the world differently, autistic students experience various challenges that could hinder academic progress (Accardo et al., 2019; Brownlow et al., 2015; Lai

& Baron-Cohen, 2015; Roberts, 2010; Sarrett, 2017). These challenges are particularly acute during the transition from secondary to higher education, including adapting to academic responsibilities, social and emotional adjustments, housing, and self-advocacy. This examination of the history of autism reveals that there is still no definitive approach to diagnosing, treating, or accommodating neurodiverse individuals. Additionally, there is no consensus regarding the nature of autism. Autistic students face the burden of unsettled science regarding their identity (Brignell et al., 2018; Howe & Stagg, 2016; Kingsbury et al., 2020; Sarrett, 2017; Shattuck, 2014).

Neurodiversity and Identity Threat

Neurodiverse individuals face a crisis of identity in virtually every social encounter. There is a great deal of literature that describes the difficulties that autistic people experience in understanding the neurotypical world. There is almost no discussion of the difficulty of the neurotypical world in understanding autism. There is no general agreement on the nature of autism (Brignell et al., 2018; Lai & Baron-Cohen, 2015; Roberts, 2010; Sarrett, 2017). There is little consensus on the best supports and accommodations for autistic individuals. A continual struggle exists between neurodiverse advocates and clinical professionals over defining autism as a difference or a deficit. DSM-5 (American, 2013) lists diagnostic criteria for autism, which are all deficit-oriented. These include lack of eye contact, inadequate response to social interactions, lack of empathy, deficit in verbal and nonverbal communication, and inability to adjust to changes in their environment adequately. Baron-Cohen (1990) has asserted that a principal characteristic of autism is *mind-blindness* or a failure to recognize the mind of another. According to Baron-Cohen (1990), mindblindness is the cause of limitations in social interaction among those on the autism spectrum.

Deficit perspectives are inadequate for two reasons. First, a deficit description of autism is incomplete (Kingsbury et al., 2020; Ortiz, 2020; Shattuck, 2014). Such a perspective of autism overlooks many pervasive characteristics among the neurodiverse community. Cognitive strengths, creative perspectives, and orientation to minute detail are all beneficial tendencies prevalent among autistic individuals (Feinstein, 2018; Grandin, 2009; Robison, 2007). These traits may be seen as positive characteristics and advantages in the classroom and the workplace. Secondly, a deficit perspective is inadequate because it conveys the idea that something is lacking or missing in an autistic person. The deficit perspective stigmatizes autism by implying a normative view of humanity. This normative view presupposes that only one genuinely normal expression of human cognition and social communication exists. Such a perspective disadvantages neurodiverse individuals because the deficit perspective creates a preconception that autistic individuals are somehow less than other individuals. This prejudicial presumption can negatively influence academic life, employment, and research (Brignell et al., 2018; Feinstein, 2018).

Societal assumptions regarding autism can expose neurodiverse individuals to the internal experience of stereotype threat. Stereotypes are socially constructed assumptions about groups or members of groups that serve as a cognitive shortcut for dealing with perceived differences (Priscott & Allen, 2021). Whether accurate or inaccurate, these perceptions often threaten the social, academic, and personal well-being of members of those groups. The sense of threat is commonly an anticipation of adverse outcomes. (Priscott & Allen, 2021). Meador (2018) described stereotype threat as the apprehension that comes from engaging in certain behaviors that could confirm negative attributes commonly associated with minority group membership. Conversely, stereotype threat also occurs when a particular minority group experiences the

pressure to disprove existing stereotypes (Hull et al., 2017; Meador, 2018; Priscott & Allen, 2021).

The anticipation of stereotype threat can be more damaging than the actual stereotype (Priscott & Allen, 2021). There is an extensive repository of literature on issues of inclusiveness and stereotype threat regarding race, gender, and visible disabilities. Still, very few studies relate to the neurodiverse experience of inclusion. (Hull et al., 2017; Priscott & Allen, 2021).

Although minorities comprise an increasing portion of the population, researchers have noted fewer minority students pursuing bachelor's degrees. Of those students from a minority background who chose to major in a STEM field, only 16% finished their degree within five years (Meador, 2018). Almost half of students who enter college drop out without completing a bachelor's degree, and nearly 30% of U.S. students will drop out during their first year of college (Silver Wolf et al., 2017). Much support for incoming students focuses on academic success and integration. Persistence among minority groups requires institutional commitment to social support and social integration. Academic integration is usually a measure of students' academic performance. Social integration addresses interactions and involvements with non-academic aspects of college or university society, such as intramural activities or on-campus clubs (Estrada et al., 2019; Jüttler, 2020). Minorities do not always find culturally relevant societies to join.

The Needs of Neurodiversity

Although the body of research on neurodiversity is growing, very little research directly addresses autism support for adults in STEM programs (Accardo et al., 2019; Freund, 2020; Schreffler et al., 2019). Very few schools have taken the initiative to examine the pedagogy and departmental structures that might single out or hinder the success of otherwise capable autistic students (Roberts, 2010; Sarrett, 2017). Most supports use a one-by-one approach rather than adapting for students with significant unique skills that benefit the field academically and

industrially (Sithole et al., 2017; Tomlinson & Newman, 2017). While many needs can be addressed on a case-by-case basis, this approach has not shown to significantly improve persistence or academic achievement for neurodiverse students specifically because it does not address the underlying needs of social integration and pedagogical reform (Bailey et al., 2019; Schreffler et al., 2019). Additionally, these supports do not necessarily address all of the needs of STEM programs, which include providing preparation for research and project development (Robert & Carlsen, 2017). As the global market advances, STEM educators are tasked with developing new learning opportunities that will prepare a technically proficient workforce to meet the changing needs of a digital information age (Thompson et al., 2019). As a result, STEM education learning outcomes have already become a moving target (Hunter, 2019; Leung, 2020; Robert & Carlsen, 2017). Compounding this situation with the unique educational approaches of the neurodiverse community can present almost insurmountable challenges (Accardo et al., 2019; Bailey et al., 2019).

There is a great need for additional research focusing on neurodiversity as a difference rather than a disability. There is also a need to assess research methodologies used to understand neurodiversity (Brignell et al., 2018; Ortiz, 2020). The unique social interaction and communication challenges often associated with neurodiversity can have a direct influence on the willingness of autistic individuals to interact with new people and experiences. These characteristics hinder researchers from using traditional approaches such as interviews and observation to obtain data (Donachie et al., 2017; Haas et al., 2016; Lai & Baron-Cohen, 2015; Sarrett, 2017).

Many in the neurodiverse community note two specific deficiencies in a great deal of autism-related research. First, almost all but the most recent research approaches autism from a *deficit* perspective (Cameron & Cooper, 2021; Gillespie-Lynch et al., 2017; Haas, 2016;

Jaysane-Darr, 2020; Roberts, 2010). Assumptions about needed supports that are based on a medical disability approach are generally unhelpful or even harmful from the perspective of the neurodiverse community. In many cases, remedial approaches are focused on correcting the autistic difference rather than accommodating it (Brignell et al., 2018; Cameron & Cooper, 2021; Moseley & Pulvermüller, 2018). In such cases, the corrective prescriptions addressed the behavior and communication challenges experienced by autistic individuals. This approach treats the student as the source of problems without considering other remedial approaches.

Students have repeatedly reported inappropriate accommodations and mismatches between their stated needs and those provided (Jaysane-Darr, 2020; Seok et al., 2018; Sithole et al., 2017). It is vital to understand that many accommodations afforded to individuals or groups are intended to improve access to content. Thus, individuals with physical disabilities or members of underserved minorities may benefit from this access. The neurodiverse community, however, will not necessarily benefit from these accommodations because their need relates to how teaching is approached more than what is taught (Jaysane-Darr, 2020; Kingsbury et al., 2020; Ortiz, 2020). Indeed, neurodiverse individuals may also experience medical conditions or physical disabilities or be members of underserved minority groups. Research indicates that autistic individuals experience higher than average rates of some medical conditions such as epilepsy, immune deficiencies, nervous system deficiencies, and gastrointestinal disorders (Lai & Baron-Cohen, 2015). Such conditions could present challenges for students in traditional classrooms. This suggests they could experience the dual needs of access to the content and new education paradigms.

Secondly, research that does not foreground the voices of neurodiverse individuals is not well received. It is difficult for neurotypical individuals to understand and interpret the experiences and actions of neurodiverse individuals and groups (Donachie, 2017; Haas et al.,

2016; Kingsbury et al., 2020; Tomlinson & Newman, 2017). Inaccurate assumptions and mischaracterizations are common in this area of research (Haas et al., 2016; Ortiz, 2020). To the fullest extent possible, a participatory approach should be followed in research and accommodations that impact the neurodiverse community to mitigate unintended consequences (Davidson & Orsini, 2013; Feinstein, 2018; Kingsbury et al., 2020).

Universal Design for Learning

In his book *Teaching to Change Lives*, the late Howard Hendricks noted that Socrates based his teaching ideas on the three concepts of *the teacher's character, the teacher's compassion, and the teacher's content* (Hendricks, 1987). What we teach is a small part of causing learners to learn. The content is a limited portion of the teacher's responsibility. Bandura's (1986) concept of modeling as the engine of education requires a relational connection between student and teacher. The student must perceive that the modeling agent is like him or can communicate with him in a way that the student understands. Universal design for learning (UDL) reflects a genuine attempt at creating that modeling environment. It has limitations, and it does not meet every need. Still, it signifies a different way of thinking about the nature of education, the teacher's responsibility, and the students' importance in the planning and delivery process (Leung, 2020; Lowrey et al., 2017). As enrollment of neurodiverse students in STEM programs continues to increase, educators must endeavor to engage all students in their lessons (Chiang, 2020; Donachie et al., 2017; Schreffler et al., 2019).

The Difference of Universal Design

UDL is an education approach based on an architectural concept of equal access to buildings and roadways without requiring extensive, specialized accommodations (Rappolt-Schlichtmann et al., 2018). Barrier-free access was a concept championed by Marc Harrison, who suffered a traumatic brain injury as a child. Extensive rehabilitation impressed Harrison

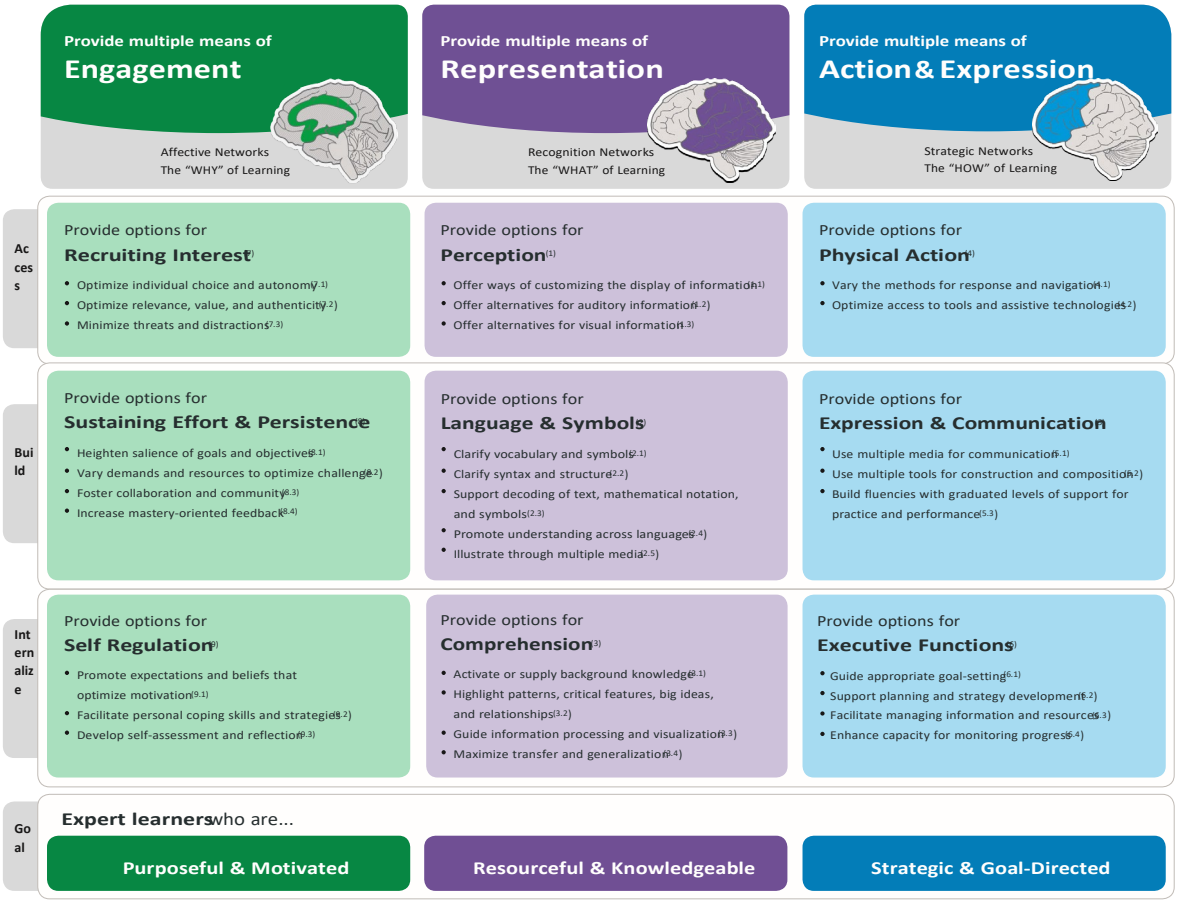
with numerous ways in which the everyday world restricted the freedom of those who were mentally or physically challenged. As an adult, he pursued a career in industrial design and pioneered innovations in housing design, product packaging, blood collection, and even food processors (*Marc Harrison,* 2017). Building on Harrison's idea, Ronald Mace began to explore the concept of universal design (Dalton et al., 2019; *Marc Harrison,* 2017). Universal design focuses on seven principles; "equitable use; flexibility in use; simple and intuitive use; perceptible information; tolerance for error; low physical effort and size; and space for approach and use. By applying these principles, the use of products and services will be equitable for most people. (Dalton et al., 2019. p.1)."The pedagogical approach is based on the seven principles of the original architectural concept.

Universal Design as a pedagogical approach is based on the seven principles of the original architectural concept. The Center for Applied Special Technology, now known by its acronym, CAST, developed a series of accessibility principles for education (CAST, 2018). CAST structured the principles of UDL around Vygotsky's (1962) work on learning as a developing relationship between language and thought. Vygotsky maintained that virtually all learning experiences are products of social interaction. The social environment—cultural expressions, language, and established institutions and conventions—are the tools that foster learning. Learners can internalize and organize new information through the social experience (Vygotsky, 1962). The essential nature of social connection is foundational in UDL. CAST describes three reasoning networks within the learner that are engaged in the learning process. The affective learning network engages the student in the learning task and motivates the student to learn. The cognitive network recognizes the information and content to be discovered. The strategic network develops an approach for internalizing and assimilating the information. UDL is designed to improve students' likelihood of accessing learning opportunities through all three

networks. These three learning networks are the basis of the CAST model of UDL represented in Figure 3, which was retrieved from the CAST website (CAST, 2018).

Figure 3

Universal Design for Learning Guidelines



From CAST (2018). Universal Design for Learning Guidelines version 2.2. Retrieved from http://udlguidelines.cast.org

Figure 3 represents CAST's (2018) three essentials for UDL success. First, successful learning engages all learning networks. Affective learning engages the "why" of learning- the student's motivation to begin and to continue learning. Recognition learning engages the "what" of learning- the information and content the students must master. Strategic learning engages the "how" of learning- the process of adapting to communicate and use the new information.

Secondly, successful learning is more readily accomplished through classroom approaches involving multiple teaching methods. UDL instruction follows the principles of various means of engagement—motivating students through a variety of pathways and numerous means of representation—presenting informational content in different formats and multiple means of action and expression—providing opportunities for students to demonstrate their understanding in various ways. Finally, successful learning is enhanced by clearly defined approaches and practical assessments. CAST clarifies each learning principle with multiple guidelines for learning structure. These structures are further expanded through practical strategies to accomplish the guidelines.

UDL focuses on pedagogy, performance evaluation, and student engagement in education. (Bastoni, 2020; Capp, 2017; Sarrett, 2017; Seok, 2018). The aim of UDL is not to create accommodations for each unique category of needs but to structure pedagogy and accommodation to meet individual needs while ensuring that the curriculum is accessible to all students (Capp, 2017; Carrington et al., 2020; Freund, 2020; Hunter, 2019). These accommodations should include considerations for interaction, knowledge acquisition, and technology use. Additionally, the UDL structure should benefit students and faculty as well (Lowery et al., 2017; Scanlon et al., 2018). UDL is intended not only to enhance the accessibility of the curriculum to nontypical learners but also to create an environment of cooperative learning and support, which will increase student body or departmental cohesion and give all students a greater sense of belonging within the academic environment (Bastoni, 2020; Felege et al., 2018; Rappolt-Schlichtmann et al., 2018). UDL is intended to increase the modes of representation of knowledge through adaptive lesson plans, improved action and expression of knowledge, and increased student engagement (Carrington et al., 2020; Schreffler, 2019; Steele, 2016).

Bandura's social cognitive theory (1986) is based on the reciprocal interactions between behavioral, environmental, and personal variables. The theory asserts that much of learning occurs in a social context. Interaction, observation, imitation, and refinement develop many skills and cognitive mechanisms. This is especially significant in the study of neurodiversity since many autistics face challenges with socially acquired cognition and developing and refining social skills. The evidence suggests that autistic students do not learn in the way that subjects are traditionally taught (Carrington et al., 2020; Kingsbury et al., 2020; Ortiz, 2017). Because social learning involves a cyclical learning process through imitation, the learning process can be disrupted if specific abilities, such as the tendency to imitate, are absent. Some autism traits could manifest due to inadequate functioning of the social learning cycle rather than dysfunction of brain mechanisms (Bailey et al., 2019; Kingsbury et al., 2020). Neurodiverse individuals may also encounter difficulties with social learning due to confusing reinforcements. Reinforcement conditions the individual to maintain or discard specific learning or behavior. For a neurotypical individual, the internal portion of reinforcement may be the sense of satisfaction derived from the mastery of a social skill. For neurodiverse individuals, this mastery may come at a far greater cost and only serve to remind the individual that the next accomplishment will demand just as much effort (Gillespie-Lynch et al., 2017; Haas et al., 2016). This can serve to dissuade autistic children from trying to adapt to a cultural norm that is already complex and somewhat alien to them. Proper accommodations not only help to prepare autistic students for success in academia and employment, but they also result in a diminished need for accommodations over time (Brownlow et al., 2015; Capps, 2017; Roberts, 2010; Sarrett, 2017).

The Benefit of Universal Design

Alexander Astin's (1999) student involvement theory was initially developed as a response to

traditional content-first pedagogical approaches focused on institutional policies and programs from a curriculum perspective. Such approaches tend to put the student in a passive role (Sithole et al., 2016; Thompson et al., 2019). Passive students easily withdraw, transfer to other institutions, or fail to persist (Astin, 1999). Student involvement theory encourages educators, department leaders, and administrators to focus less on content and programs and more on the student. The goal of pedagogy should always be student success academically and in their chosen career. These ideas align with the fundamentals of UDL (Lowrey et al., 2017; Scanlon et al., 2018; Schreffler et al., 2019).

In addition to flexible and adaptive teaching approaches, UDL is intended to improve learning outcomes for all students (Capps, 2017; Charity et al., 2017; Freund, 2020; Schreffler, 2019). This approach employs various teaching and environmental tools to make learning more accessible for all students. UDL fosters social integration through collaborative and other learning approaches. This approach helps to address the critical need for social integration, which is an incredible challenge for many autistic students. In addition to decreasing the academic barriers, UDL in postsecondary education also provides a level of comfort for neurodiverse students, improving their sense of belonging and self-efficacy. UDL can also help open new academic and career pathways for students they may have yet to consider (Freund, 2020; Schreffler et al., 2019). Adapting pedagogy in STEM programs to include the learning habits of neurodiverse students will improve academic success (Bailey et al., 2019; Kingsbury et al., 2020; Sithole et al., 2017). UDL approaches allow greater communication and socialization between neurodiverse and neurotypical students. According to Astin (1999), student involvement, a key predictor of persistence, is described as a product of time on campus, time and effort invested in studies, extracurricular activities, and direct communication with students and faculty. Additionally, retention and persistence are directly linked to the student's sense of

belonging in college. Institutions can enhance retention and improve persistence by structuring classes and extracurricular activities to encourage engagement (Burke, 2019; Sithole et al., 2017).

Almost sixty percent of students who enroll in STEM programs fail to persist. Less than forty percent of autistic students complete a four-year degree despite enrolling at a higher rate than neurotypical students (Accardo et al., 2019; Burke, 2019). Differences in learning approaches can account for a significant portion of academic attrition. UDL, initially developed for elementary and secondary education, is not widely used in STEM programs. Postsecondary programs designed from a UDL perspective, including extensive use of technology applications, can provide students with numerous forms of access to the curriculum (Capps, 2017; Kingsbury et al., 2019; Unluol Unal et al., 2020). Students benefit from a UDL approach whether they experience intellectual or social diversity. UDL allows students to become more engaged and committed to persistence in their education.

The Challenge of Pedagogy

Developing a pedagogical approach that is inclusive of autistic students involves recognizing the unique characteristics of those students. Many individuals with autism spectrum conditions tend to exhibit avoidance behaviors. Research suggests that this behavior is likely to be due to the consequences of living with autism spectrum conditions. Repeated social failures and sensory hypersensitivity can increase the desire to evade social situations. Repeated social misunderstandings and difficult experiences can also lead to paranoid ideation, which hinders students' abilities to integrate into academic settings as well as social ones (Lai & Baron-Cohen, 2015; Sarrett, 2017). Additionally, autistic individuals tend to experience their surroundings concretely. Idiosyncratic speech and thought are markedly pronounced in autism spectrum conditions. For many autistic individuals, metaphors or other figures of speech present

communication challenges. Lack of routine structure or disruptions of routines is also problematic for neurodiverse students to navigate.

Pedagogical Needs of the Neurodiverse

There is very little literature that considers the educational needs of autistic students from the perspective of the students (Bailey et al., 2019; Roberts, 2010; Brownlow et al., 2015). Specifically, more research is needed to define the social aspects of learning concerning autism, the environmental adaptations, and performance evaluation methods that will genuinely assist and assess neurodiverse students (Ortiz, 2020). Additionally. The neurodiverse community needs more of a voice in pedagogical design, planning, and even the approaches used to research the needs and benefits to the neurodiverse community (Capps, 2017; Donachie, 2017; Kingsbury et al., 2020). The lack of research regarding academic support for neurodiverse students is replicated in the non-academic world. There is a significant lack of research support for neurodiverse students in academic and career environments. Both as students and employees, autistic individuals enhance educational and employment institutions when provided with effective support. (Brooke et al., 2018).

The daily experiences of the neurodiverse community highlight the importance of participatory research and planning. Many everyday events for neurotypical students can be stressful for autistic students. Group learning settings and teamwork approaches may help neurodiverse students to overcome some weaknesses and better employ their academic skills, but they may also hinder those same students due to social interaction challenges (Leung, 2020; Ortiz, 2020; Schreffler et al., 2019). Many social activities, although relaxing for most students, may increase feelings of stress in autistic students (Bailey et al., 2017; Kingsbury et al., 2020; Sarrett, 2017). Additionally, researchers have reported that some traditional research methods have regularly proven counterproductive when studying neurodiverse participants (Bailey et al.,

2017; Kingsbury et al., 2020; Ortiz, 2020). Because the personalities of neurodiverse individuals are as varied as those of the neurotypical community, a *one-size-fits-all* approach is unlikely to improve inclusiveness in academics, research, and social integration. A successful strategy includes options, flexibility, and acceptance (Haas et al., 2016; Schreffler et al., 2019).

Theoretical models emphasizing student engagement and a sense of belonging must be applied to institutional structures and pedagogy to accommodate autistic students. Supporting neurodiverse students in social integration will require adjustments of traditional paradigms as the neurodiverse often experience community and communication in unique ways (Accardo et al., 2019; Burke, 2019; Kingsbury, 2020).

The Uniqueness of STEM

Though he had little formal education, Benjamin Franklin was passionately committed to establishing an English school in Pennsylvania (Benjamin Franklin, 1944). He envisioned the value of an educated population for the future of the New World. Franklin recommended that schoolmasters devote themselves to preparing students to be equipped with the inclination and the ability to "serve Mankind, one's Country, Friends, and Family" (Franklin, 1749, p. 30). Franklin's vision emphasized the benefit to the student as measured by the graduates' usefulness to society.

The idea of an elective curriculum is attributed to Charles Eliot, president of Harvard, at the turn of the twentieth century (Lucas, 2006). Many higher education institutions followed this broadening of the definition of higher education. Motivated by financial needs, many universities have made marketing decisions that ceded power to prospective students (Lucas, 2006). This unique feature distinguished American education from that of its European ancestors. Students generally pursue higher education to achieve their goals, whether for financial gain, seeking

specific employment, or personal satisfaction. Most higher education degrees are structured to accommodate the desires of the student body.

By contrast, STEM programs reflect a different aim. During the Civil War era, long before the coining of the acronym STEM, the Morrill Land Grant Act of 1862 provided for a proliferation of colleges tailored for agricultural and industrial education (Geiger, 2013). These science and technology-oriented colleges aimed to meet the specific needs of a growing nation. In the 1940s, when WWII spurred a host of technological innovations, including transportation, communication, and the atomic bomb, The National Science Foundation (NSF) was formed at the end of the war to preserve the scientific and technological advances accomplished during the war effort (White, 2014). The goal of the NSF was to help keep the United States technologically competitive against any future hostile entities.

The space race of the 1950s and 1960s led to an acute need for highly qualified engineers and mathematicians (Catterall, 2017; McComas & Burgin, 2020). The Apollo moon landings were among the early triumphs of national science and engineering programs (White, 2014). The following decades were marked by rapid technological developments, especially in electronics and communication. The age of cell phones, personal computers, and other consumer-related technology prompted private industries to partner with the federal government to promote STEM-related initiatives to support an increasing need in the labor market (Gardner, 1983; Penprase, 2020; White, 2014). Medical advances, improved military weaponry, and advances in space exploration also grew out of the growing STEM fields of education and research (Catterall, 2017; White, 2014). The U.S. National Academies of Science, Engineering, and Medicine announced that students in the United States were dangerously trailing students in other countries in STEM education. Their report called for immediate action to promote and support STEM

education to prepare our next generation of labor to compete in a global marketplace (Gardner, 1983).

During the 1990s and 2000s, educational leaders began to work toward standardizing science and engineering classroom guidelines (McComas & Burgin, 2020; White, 2014). The NSF coined the acronym STEM, representing a unified educational approach to teaching science, technology, engineering, and math (McComas & Burgin, 2020; Mohr-Schroeder, 2015). The goal of the NSF became more focused on building a science and technology-ready labor force that could keep the United States competitive in a global market.

During their tenure in office, Presidents Bush and Obama enacted education legislation intended to expand access to and innovation in STEM programs. In each case, the stated reason for the initiatives was to meet the nation's needs in a competitive global economy (Cavanagh, 2009; H.R.1, 2001; Mohr et al., 2015; Park et al., 2020; S.1177, 2016).

Unlike most educational pursuits, STEM programs are designed to specifically accommodate the societal needs of the nation or private industry. Private industry and government agencies promote STEM learning to secure a reliable labor force (Ng et al., 2021; Jang, 2016; Robert & Carlsen, 2017; Wild, 2018). They also provide vast financial incentives to institutions that produce skilled laborers for STEM fields. The result is a content-heavy approach to STEM teaching to accommodate the perpetual needs of industry. Elementary students are targeted by numerous STEM initiatives to steer them toward a STEM career (Allen et al., 2019; Mohr-Schroeder et al., 2015; Ng et al., 2019). No such initiative exists for promoting a career in history or literature.

The collaborative effort by government and industry to produce a labor force for society's benefit has created two pedagogical challenges. First, it represents a backward step in using higher education to limit the student's options for the benefit of society. Dr. Eliot’s ideas are in

jeopardy of being lost in such a program (Lucas, 2006). Students' wishes or ambitions may be overwhelmed by years or perhaps decades of promotion of a single idea to the exclusion of others. Prompted by such promotion, some students may find themselves in fields of study for which they have no personal passion or motivation. Bandura (1977; 1986) repeatedly observed that personal motivation is critical to cognitive development. Secondly, this drive to produce a product—a labor force—can overwhelm sound pedagogical approaches. STEM programs focus on content rather than learning theory (Leung, 2020; Robert & Carlsen, 2017). Many STEM teachers have noted that their education was primarily content and that they are not well equipped to address the unique needs of students who learn differently (Lang & Persico, 2019; Shukla et al., 2019). They find themselves perpetuating the content-heavy approach that they received.

The almost perpetual shortage of qualified STEM teachers has created a crisis that hinders the development of a sustainable STEM professional workforce that can meet the needs of a growing market worldwide. Many science and engineering professionals have entered the classroom to share their expertise with a new generation of engineers (Antink-Meyer & Brown, 2017; Gess-Newsome & Lederman, 1999). Career professionals can bring immense knowledge and experience to the classroom. Professionals seeking a second career as teachers have helped overcome the shortages of teaching professionals in these areas. They also bring organizational and managerial skills as well as their subject expertise. Many colleges have programs designed to facilitate the transition of STEM-related professionals to the classroom through expedited teacher certification programs (Antink-Meyer & Brown, 2017; Garcia et al., 2021). The National Science Foundation (NSF) supports STEM teaching as a second career through grants and scholarships like the Robert Noyce Teaching Scholarship, which is intended to attract scientists and engineers into the field of high school teaching (Morrell & Salomone, 2017).

Because many STEM educators come from professional occupations outside the classroom, their classroom practices may vary significantly from those of education professionals. The emphases of their first career were often practice over theory and production over communication (Antink-Meyer & Brown, 2017; Gess-Newsome & Lederman, 1999). Career changers prefer teacher-centered practices when they begin their teaching careers because these approaches focus on content more than outcomes. Some researchers suggested that this focus is likely due to prioritizing their professional practices and skills more than the classroom standards of education and learning goals (Antink-Meyer & Brown, 2017; Smetana & Kushki, 2021). Many second-career teachers struggle with identity conflicts when confronted with new pedagogical approaches and relationship-building challenges. Studies also indicate that many teachers are eager for resources to facilitate greater student engagement in the classroom (Antink-Meyer & Brown, 2017; Gess-Newsome & Lederman, 1999; Smetana & Kushki, 2021).

Summary

Autism is generally described as a disorder by the APA, a disability by government agencies, and a difference by autism advocacy groups. These varying descriptions can create identity instability for autistic students as they navigate the academic landscape. Additionally, such labels can lead to stereotypical assumptions by peers and professionals, which impact the opportunities for autistic students to reach their full academic potential. The Centers for Disease Control reports that as many as one in 54 children in the United States experience some degree of ASC (Autism, 2020). Many young adults on the autism spectrum want to enjoy independence, meet their academic goals, and work in their desired field of employment. Autistics who are interested in STEM-related fields face numerous challenges. Much of the neurodiverse experience revolves around communication or perhaps the lack of communication (Tomlinson & Newman, 2017). Often, this poses a significant challenge for autistic individuals. This is

highlighted by the reality that many neurodiverse individuals struggle in social settings (Jaysane-Darr, 2020). Many neurodiverse individuals miss opportunities because they express themselves differently. Differing communication styles can hinder completing classroom assignments, a successful job interview, or participating in research (Haas et al., 2016; Lai & Baron-Cohen, 2015; Tomlinson & Newman, 2017). A review of the literature showed that though autistic students are provided with accommodations in universities, autistic students continue to experience significant issues in higher education institutions because of stereotype assumptions, misconceptions, pedagogical or social barriers, and lack of an inclusive curriculum. Although academic institutions offer numerous accommodations to students, it is uncertain how relevant they are for students on the autism spectrum.

Bandura's social cognitive theory situates self-efficacy as a product of reciprocal interactions of personal, environmental, and behavioral variables. These three factors form his framework of triadic reciprocality. Researchers have indicated that the primary challenges faced by autistic students are communication deficits, social interaction challenges, and a limited range of interests (Bailey et al., 2019; Donachie et al., 2017; Ortiz, 2020). The research questions in this study explore the intersection of Bandura's triad and the identified autistic challenges.

There is a distinct lack of research that addresses pedagogical approaches while foregrounding the experience of the neurodiverse students in their voices. This study helped give voice to the perception of those most impacted by these challenges to better inform changes and adaptation in pedagogy and environment.

CHAPTER THREE: METHODS

Overview

Understanding the experiences of neurodiverse students is necessary to ensure that they receive the support they need to progress and persist in their academic and life goals. This transcendental phenomenological study explored the perceived self-efficacy of autistic students in STEM-related fields of study. This chapter describes the design and presents the research questions being studied. The procedure and the researcher's role are explained. Detailed information concerning data collection and analysis are presented. Trustworthiness and ethical considerations are also addressed in this chapter.

Research Design

My goal in pursuing this qualitative study was to describe the perception of self-efficacy among autistic students currently enrolled in STEM programs in four-year institutions in the United States. Qualitative research was the correct approach for this purpose because the goal was to study the participants' subjective experience in-depth and in detail (Patton, 2002). Qualitative research is designed to uncover an authentic description of the participants' lived experiences from their perspective (Creswell & Poth, 2018). Moustakas (1994) noted that there is no evidence for objective reality apart from the subjective experience and perception of those who encounter it.

The qualitative method uses interpretive and theoretical frameworks to study problems addressing complex, detailed social or human problems (Creswell & Poth, 2018). In addressing the complexity and rigor of qualitative research, Creswell (2013) described qualitative research as a process of inquiry guided by a theoretical framework and sensitivity to the meaning ascribed by the participants in the research. He noted that an emerging approach to inquiry and data collection in a natural setting were critical elements of the qualitative process. The final report of

such an inquiry relies on the participants' voices and the researcher's reflections (Creswell & Creswell, 2018; Levitt, 2020; Maher & Neale, 2019). The researcher has provided a complex description of the research problem, including the research's contribution to the existing body of knowledge (Creswell & Poth, 2018; Maher & Neale, 2019). By its design, qualitative research is exploratory and interactive (Creswell & Poth, 2018; Pathak et al., 2013). This was the correct approach to give voice to the participants as they collaborated in the research process.

This researcher followed a phenomenological design to understand a phenomenon and the lived experiences of a particular group of individuals (Creswell & Poth, 2018; Moustakas, 1994). Phenomenology as a qualitative research design traces its roots to Edmund Husserl, who championed the design as a way to understand the context of the lived experiences of people and the meaning of their experiences (Husserl, 1931; Moran, 2002). Husserl proposed a research approach that accounted for human conscience and experience in contrast to the scientific method, which accounted only for objective data.

Phenomenology was a useful design for this study because it helped to address the limited nature of communication and interaction that could occur while conducting research with autistic students (Curtis-Wendlandt & Reynolds, 2020; Høffding & Martiny, 2016). Smith and Osborne (1996) noted that phenomenology recognizes a dual hermeneutic approach in which, while "the participants are trying to make sense of their world; the researcher is trying to make sense of the participants trying to make sense of their world (p. 266)." A transcendental phenomenology seeks to describe the essence or "textural and structural meanings of an experience" (Moustakas, 1994, p. 60). Transcendental phenomenology was a helpful design for this study because it provides precise data collection and analysis procedures. According to Moustakas, a defined approach strengthens the research outcomes because "a method offers a systematic way of accomplishing something orderly and disciplined, with care and rigor (1994.

p. 104)". Clear procedural guidelines were helpful to guide a new researcher in understanding and describing the lived experience of the participants. Moustakas's process includes the four characteristics of phenomenology: description, reduction, imaginative variation, and essence (Moustakas, 1994). Additionally, Moustakas emphasizes the idea of intentionality—consciously directing one's attention toward an object, one could form a description of the phenomenon.

Phenomenology is characterized by the practices of induction and description (Moustakas, 1994). The lived experiences of individuals were examined and described to reflect how they make sense of or interpret their world (Husserl, 1931; Moustakas, 1994; van Manen, 1990). Husserl (1931) described the everyday experience of individuals as their *lifeworld*. In phenomenology, the researcher seeks to faithfully represent the composite essence of the shared lifeworld experience of the participants. Moustakas (1994) noted that this description consists of the *what* and the *how* of their shared experience. Phenomenology aims to describe the fundamental essence of shared expertise while accurately representing the reflections of the individuals who experienced the phenomenon.

Although hermeneutic phenomenology (Heidegger, 1982; van Manen, 1990) and transcendental phenomenology (Husserl, 1931; Moustakas, 1994) hold similar ideologies about the nature of data and the construction of knowledge, a critical distinctive between hermeneutic and transcendental phenomenology is the position of the researcher. Hermeneutic phenomenology positions the researcher as a source of data that is co-equal with the other participants. Van Manen (1994) asserted that his own life experiences were the data set best known to him and an integral component of the essence of a phenomenon. Hermeneutic phenomenologists interpret the nature of a phenomenon aided by their own experiences. Contrastingly, transcendental phenomenology situates the researcher outside the data (Husserl, 1931; Moustakas, 1990; Sokolowski, 2000). Transcendental phenomenology demands an

intentional suspension of judgment about a phenomenon to discover the revealed knowledge generated by those who experienced the phenomenon. Sokolowski (2000) described this suspension of judgment as a genuine phenomenological attitude in which the researcher sets aside his natural participation to examine the meaning of participating in the world. This suspension or *epoché*, termed by Husserl (1931), is foundational to transcendental phenomenology. Transcendental phenomenologists aim to describe without bias the essence of the experiences shared by the participants (Patton, 2002). The purpose of transcendental phenomenology is to discover the irreducible essence of an experience, which may have broader application beyond those who experienced it (Husserl, 1931; Moran, 2002). Transcendental phenomenology is well suited to describe the experience of autistic students because transcendental phenomenology "is concerned with wholeness, with examined entities from many sides, angles, and perspectives until a unified vision . . . is achieved (Moustakas, 1994, p. 58) ". This research design provided a structure to integrate diverse views to describe a multifaceted yet cohesive essence.

Research Questions

The perception of self-efficacy is essential to social learning (Bandura, 1977, 1997b). Cognitive development and learning are influenced by social integration, communication efficacy, and environmental acclimation (Bandura, 1986). Because autistic students may struggle with these learning skills, traditional classroom environments, and pedagogical approaches do not always support their academic needs.

Central Research Question

What are the self-efficacy experiences of neurodiverse students currently enrolled in a STEM program at four-year institutions in the United States?

Sub-Question One

How do autistic students in STEM-related fields of study experience the social campus environment?

Sub-Question Two

How do autistic students in STEM-related fields of study perceive the academic supports and accommodations that they receive?

Setting and Participants

This section of the proposal will discuss the site selected to execute the study and the profile of the participants. A pseudonym will be used to discuss the site. The university's size, the organizational makeup, and the reasons it was chosen for the study will be explained. Additionally, participants' characteristics and the criteria for selection will be explored in this section.

Site

The research occurred in two four-year institutions in the United States. Greenwood University (pseudonym), in the Northeast, was chosen because it has a thriving and varied engineering department with a long history of graduation success and prosperous employment for its STEM students after graduation. The school offers numerous engineering degree programs and is widely recognized as diversity-oriented. As a state-supported institution, the school must meet government-mandated guidelines for inclusivity and student persistence. The college has begun implementing some of the principles of universal design for learning (UDL) in its pedagogical approaches. This transition period provided an opportunity for observation and comparison while the changes remained fresh in the participants' minds. The university has an enrollment of over 39,000 students on seven campuses in the northeast United States and international campuses. A board of trustees oversees Greenwood University. A president and a leadership staff administer the university in conjunction with eleven academic deans. Hightower

University (pseudonym), located in the South, is a private research university with approximately 14,000 students enrolled in ten colleges on a single campus. A Board of Trust governs the university. The chancellor, whom the Board of Trust elects, is the chief executive officer of the university.

Miles et al. (2014) cited six criteria that should drive site and sampling selections: 1) relevance to the theoretical framework and research questions, 2) information richness, 3) likelihood of enhancing the generalizability of findings, 4) likelihood of generating believable, real-life descriptions, 5) ethics, and 6) feasibility of data collection. These two sites were selected because they meet all of these criteria. Each institution has many neurodiverse students enrolled in award-winning STEM programs. The differences between the sites, geography, demographics, funding, and administration enhance the generalizability of the findings. Both schools have strong histories of helping autistic students acclimate to the academic environment and transition from the classroom to employment in the STEM field. Both schools are committed to inclusive pedagogy and providing adequate support and protection for their student body. These institutions have support centers dedicated to advocating for the success of neurodiverse students. These schools have significant populations of autistic students, improving the chances of sufficient participation to achieve saturation in data collection. Finally, these institutions allowed all data collection to occur online, facilitating the research.

Participants

In this study, the sample participants were categorized by their university as autistic and currently enrolled in the STEM program. There is no established rule for the number of samples in qualitative research (Gall et al., 2007; Patton, 1990). Researchers generally agree that sampling for qualitative research tends to emerge and evolve during fieldwork (Curtis et al., 2000; Miles et al., 2014; Patton, 1994; van Manen, 1994). The students were all acknowledged

by their institution to have been diagnosed with ASC. The institution's standard for diagnosis was accepted for this research, provided that the same assessment standard is applied to all of their students. The students were all currently enrolled in STEM-related majors and had completed at least one year of higher education at the time of their recruitment into this research. They all experienced mild to moderate influence of their autistic condition, meaning that they had reasonable communication skills and could progress in a typical school environment to some extent, possibly with personal teacher support. Two characteristics of autism that could impact data collection are that some autistic individuals experience difficulties with abstract and hypothetical thinking or challenges due to sensory sensitivity (VanderBroek Stice & Lavner, 2019). No attempt was made to exclude students with these challenges because a salient point of the research involves bridging communication and environmental gaps that might hinder persistence among autistic students.

Researcher Positionality

In qualitative research, the researcher's standpoint is an essential consideration for validity. Researcher bias or relationship to participants can hinder the reliability of findings (Høffding & Martiny, 2016; Pringle et al., 2011). In this particular research, I have an advantage. I have no direct connection to the institution, the department, or the personnel. I do not know the students. I have no background in STEM education. Additionally, I have had little experience with autistic students. My current efforts aimed to understand how to establish rapport and improve communication. These efforts were to maximize the data collected from interviews and focus groups. While I am a proponent of UDL as a teaching strategy, I have no experience regarding its effectiveness in STEM programs. As I assess these factors, I recognize that, although I am not biased by personal experience, I am still subject to potential biases that could impact my research. The fundamental principle of phenomenology—to seek to understand an

experience—is my only real aim. This is the heart of the challenge in this study: the communication and interaction limitations often experienced by neurodiverse students. My role as the researcher was to reflect and describe the experiences of the participants accurately. This required a suspension of judgment and a careful examination of the collected data. The most challenging aspect of the *epoché* process is recognizing that my perspectives as a Biblical Christian influence every facet of my life, including my reasoning. Phenomenological research requires a suspension of preconceptions and an acceptance without judgment of the participants' voices. I partnered with the participants to create a detailed description that reflects their understanding of the experience (Creswell & Poth, 2018; Flood, 2010; Moustakas, 1994; Van Manen, 2016).

Interpretive Framework

The interpretive framework, or research paradigm, describes the researcher's perspective as he conducts the study. Patton (1997) defined a paradigm as a "worldview built upon implicit assumptions, accepted definitions, values defended as truths, and beliefs projected as reality" (p. 267). No researcher is free from a worldview. My interpretive framework influenced almost every facet of this study. This research was pursued from a social constructivist perspective (Creswell & Poth, 2018). A social constructivist paradigm encourages the researcher to focus on the participant's view of the phenomenon, which reflects the participants' historical and cultural experiences (Creswell & Poth, 2018; Gilgun et al., 2013). This approach is dependent on the relationship between the researcher and the participants. The participants partner with the researcher in providing and collecting data by sharing their interpretation of their experience and how they made meaning of the phenomenon.

Social constructivism emphasizes the diversity of worldviews and multiple realities. Social constructivism relies on the participants' views to develop an understanding of varied and

complex reality because it encompasses many perspectives. Constructivism is based on knowledge as socially constructed rather than objective (Creswell & Poth, 2018; Gall et al., 2015; Gilgun et al., 2013).

Philosophical Assumptions

Philosophical assumptions can change with time, experience, and career (Creswell & Poth, 2018). Philosophical assumptions influence research goals and outcomes and are deeply rooted in the researcher's experiences. Ontological, epistemological, and axiological assumptions frame the research process (Creswell & Poth, 2018).

Ontological Assumption

Ontology relates to the nature of reality and how anything can be known (Bleiker et al., 2019; Creswell & Poth, 2018). Ontologically, I recognize that there is a defined, universal reality based on absolutes established by the Creator. I also understand that many, perhaps most people, consider reality relative. Additionally, those who recognize an absolute reality also acknowledge that we only perceive a knowable reality and that our perception is probably flawed. Personal experience and situational perception guide the construction of reality for many people (Creswell & Creswell, 2018; Creswell & Poth, 2018; Gall et al., 2015). The nature of phenomenology necessitates the suspension of personal preconceptions and judgments to describe the experiences of the participants accurately. The goal of accurately representing the experiences of the participants highlights the need for the *epoché* process to isolate the issue being studied and to work with the participants as they construct their perception of reality (Husssrel, 1931; Moustakas, 1994; Van Manen, 1990).

Epistemological Assumption

Epistemology is a philosophy of the nature of knowledge (Creswell & Creswell, 2018). Epistemological views address how knowledge is obtained. I tend to espouse an objectivist view

of knowledge—that reality can be known, at least to a significant degree (Gall et al., 2015). Because I am an imperfect researcher, I recognize that my grasp of objective reality could be defective or mistaken. This knowledge helped me prepare to consider the subjective perspective of research participants as they provided me with data from their lived experiences (Moustakas, 1994; van Manen, 1990).

Axiological Assumption

Axiological beliefs describe the researcher's values and reflect how to apply the knowledge generated through research (Lincoln et al., 2011). Since social constructivism assumes that knowledge is constructed and negotiated socially (Creswell & Poth, 2018), the axiological basis for constructivism assumes that the most authentic value of that knowledge is in its contribution to social understanding and in the benefit that knowledge yields to that society (Guba & Lincoln, 2005). As I worked with the research participants to describe the essence of their experience, I valued giving them a greater voice. I wanted this research to assist those on the autism spectrum in pursuing their academic, employment, and life goals. I hope to inform the educational community regarding the pedagogical and social values held by this community. As a Christian and a spiritually conservative man, these aims are entirely in keeping with my axiological tendencies.

Researcher's Role

In qualitative research, the researcher's standpoint is crucial for validity. Researcher bias or relationship to participants can hinder the reliability of findings (Høffding & Martiny, 2016; Pringle et al., 2011). In this particular research, I have an advantage. I have no direct connection to the institution, the department, or the personnel. I do not know the students. I have no background in STEM education. Additionally, I have had little experience with autistic students. My current efforts aimed to understand how to establish rapport and improve communication.

These efforts were to maximize the data collected from interviews and focus groups. While I am a proponent of UDL as a teaching strategy, I have no experience regarding its effectiveness in STEM programs. As I stated previously, although I am not biased by personal experience, I am still subject to potential biases that could impact my research. My role as the researcher was to reflect and describe the experiences of the participants accurately. This required a suspension of judgment and a careful examination of the collected data. The most challenging aspect of the *epoché* process is recognizing that my perspectives as a Biblical Christian influence every facet of my life, including my reasoning. Phenomenological research requires a suspension of preconceptions and an acceptance without judgment of the participants' voices. My role as the researcher was to reflect and describe the experiences of the participants accurately. This required a suspension of judgment and a careful examination of the collected data. I partnered with the participants to create a rich description that reflects their understanding of the experience (Creswell & Poth, 2018; Flood, 2010; Moustakas, 1994; Van Manen, 2016).

As the researcher, I was the instrument in collecting data (Collins & Stockton, 2022; Creswell & Poth, 2018; Patton, 1980). Also, I was responsible for the research design. Selection and recruitment of participants were my responsibilities (Durdella, 2019; Patton, 1980). I conducted data collection. I generated the interview questions and prompts and provided all participants with an explanation of the purpose of the study, their rights, informed consent, and a description of each phase of the study. The researcher analyzed the data and reported the findings. The researcher was responsible for ensuring the confidentiality of records and data, including maintaining the anonymity of the participants and their responses (Durdella, 2019; Patton, 2002). Also, I explained all confidentiality issues to participants, including limitations of confidentiality. As the researcher, I was also responsible for developing a plan to address any other ethical concerns that may arise.

Procedures

Before participant interviews, each student received written and oral information about the study. Interviews occurred online via Zoom in a setting familiar to each participant. Interviews were recorded on two devices. If the participant wished, the interview happened in the presence of the institution counselor, who was currently responsible for the student's well-being and was known by the students. Each participant was asked to bring an artifact to the interview that represented a part of their experience in STEM. The researcher encouraged the participants to describe the connection of the artifact to the unique participant experience. This anecdotal description aided in triangulating the structure of the experience. A focus group session was used to verify information and address unanswered questions. Focus group data collection was also conducted via Zoom meeting and took place after individual interviews had been completed. Interviews, artifact descriptions, and focus groups were audio-recorded for transcription and review. All data collected was kept in a file on a password-protected computer. The Office of Human Research Protections (OHRP) in the Department of Health and Human Services requires human subjects research study records to be kept for a minimum of 3 years after the close of the study. Analysis of data followed principles of phenomenology.

Permissions

Institutional Review Board permission to enlist participants for this research was obtained from Liberty University and the institutions where the students are enrolled (See Appendix A). Written requests for permission were made to each institution's review boards. The request included an overview of the research, the goals of the study, samples of participant permission forms and data collection instruments, and plans for participant recruitment and data analysis.

Recruitment Plan

Upon receiving approval from the IRB of both Liberty University and the research settings, the participants in this research were purposively sampled from two four-year accredited research institutions in the United States. Purposive sampling is the process of selecting individuals who have experienced the circumstance being studied and will be able to provide rich, descriptive information for the research (Creswell & Poth, 2018; Gall et al., 2007; Miller et al., 2018). Participants were recruited by seeking volunteers from the total pool of autistic students enrolled in STEM programs among two four-year institutions. Phenomenological research assumes a criterion sampling approach that limits the eligible participants based on whether they meet specific requirements about the phenomenon being investigated (Creswell & Poth, 2018). The researcher worked with the institutions' support services to solicit volunteers for this study. Additional participants were recruited using snowball sampling. Snowball sampling is identifying other information-rich participants through the current participants. Current participants knew individuals who met the study's criteria and were willing to participate in the research (Durdella, 2019; Patton, 2002). Patton (2002) stressed that sample size is vital to understanding the issue being studied. Lincoln and Guba (1985) observed that the sample size should aim to achieve redundancy in data collection—the point at which no new information is likely to be obtained from additional participants. Other researchers have described this concept as saturation (Creswell & Poth, 2018; Gall et al., 2007). Phenomenological samples may vary from five to 25 participants (Creswell & Poth, 2018). Moustakas (1994) recommends a minimum sample size of 10 participants. Creswell and Poth (2018) suggest a range of three to 10 for phenomenology. Patton (1990) noted that determining an appropriate sample size involves a tradeoff between breadth and depth of research. The sample consisted of eleven students. Ten to twelve participants is generally accepted as a useful number to ensure rich information while providing an opportunity to develop a deep

understanding of the phenomenon (Creswell & Poth, 2018; Gall et al., 2007).

Before participant interviews, each student received written information about the study. Interviews took place online in a setting familiar to each participant. If the participant wished, the interview could occur in the presence of the institution counselor, who is currently responsible for the student's well-being and is known by the students. Each participant was asked to bring an artifact to the interview that represents a part of their experience in STEM. The researcher encouraged the participants to describe the connection of the artifact to the unique participant experience. This anecdotal description aided in triangulating the structure of the experience. Follow-up interviews collected additional data and helped build familiarity and trust with the participants. A focus group session was used to verify information and address unanswered questions. Interviews, artifact descriptions, and focus groups were audio-recorded for transcription and analysis.

Data Collection Plan

No data were collected from participants until all necessary approvals had been obtained from Liberty University's institutional review board (IRB) and from the IRB of the institution where data collection took place. Informed consent was also obtained from all participants in the research. Data collection for this research posed a unique challenge. Norris et al. (2020) noted that autistic individuals often struggle with social interaction or direct communication. Communication and social interaction are crucial functions of education and essential tools of qualitative research to gain insight into the unique perspectives of autistic students (Webb & Welsh, 2019). This study aimed to give voice to the perception of those most impacted by these challenges to inform changes and adaptation in pedagogy better. Data collection was in the form of interviews, artifact anecdotes, and focus groups.

The data analysis for this study followed the modified van Kaam guidelines recommended by Moustakas (1994). This began with *Epoché* or refraining from preconceptions and assumptions that could bias data analysis (Moustakas, 1994). Because data collection and analysis are concurrent in phenomenology, the practice of *epoché* was ongoing. The collected data was subjected to *reduction* to distinguish between relevant and irrelevant material. The process of *imaginative variation* united the discovered themes of the participants into a rich descriptive presentation of the essence of the phenomenon being studied.

Epoché

The process of *epoché* requires reflection and honesty. Moustakas (1994) notes that this is a challenging but necessary process. To understand the participants ' perspectives, the researcher must set aside preconceptions and biases about the phenomenon. Moustakas suggests that the researcher must be "naïve in listening to and hearing research participants describe their experience of the phenomenon being investigated (Moustakas, 1994, p. 22)". This is because the phenomenon being studied is not assessed, measured, or compared with objective reality but is described from the participants' perspective as they attempt to make sense of their world. *Epoché* is a Greek word meaning to abstain or avoid. The idea is that, as a researcher, I approach any phenomenon without preconceptions and prior knowledge. As Moustakas noted

> The challenge is to silence the directing voices and sounds, internally and externally, to remove from me manipulating or predisposing influences, and to become entirely and solely attuned to just what appears, to encounter the phenomenon, as such, with a pure state of mind. (1994. P. 88).

The purpose of phenomenology is not to compile knowledge but to describe the lived experience of the participants. *Epoché* requires intense personal reflection about preconceptions. This reflection and bias awareness must continue throughout data collection and analysis

(Creswell & Poth, 2018; Moustakas, 1994). Because phenomenology is an interpretive process, there is always a risk of misrepresenting the participants' experiences. Because my own experience with this phenomenon is limited, I am less likely to exhibit a bias in the research. This does not make *epoché* any less essential.

Individual Interviews

Interviews are the most common approach to data collection in qualitative research. Patton (1990) noted that interviews allow the researcher to enter into the participant's perspective because the researcher cannot learn everything by observation. Through interviews, the researcher obtains the views and opinions of the participants regarding the phenomenon being studied (Creswell & Creswell, 2017). Interviews are beneficial in qualitative research because the researcher directs the discussion expressly to the topic under study. This direction allows for a large quantity of relevant and high-quality data to be obtained from each participant (Patton, 1990). Interviews help the researcher discover the meanings people ascribe to events and experiences (Miles et al., 2014).

Participants were recruited through an initial letter of invitation (Appendix B) that included a link to a screening survey (Appendix C) to determine the respondent's qualifications for this study. Qualifying respondents received a consent form (Appendix D). Each participating respondent was contacted via email to schedule an interview time. The participant received a unique link to a Zoom meeting via email. The email also included a reminder that participants are free to withdraw from all or part of the study at any time. At the time of the scheduled interview, the researcher and participant joined the Zoom meeting, and the participant was again reminded of his rights regarding the data collected. The interview questions were asked in order, and the interview was recorded directly on the researcher's laptop and the researcher's cell phone using a transcription app. The interview questions are also available in Appendix E as an

interview guide.

Individual Interview Questions

Introductory Questions

1. Tell me something about yourself

2. What do you like most about being at this school?

3. How did you decide to enroll in a STEM program? CRQ

4. Why did you decide to enroll in *this* STEM program? CRQ

5. Please describe some of the changes you have experienced this past year as a college student. SQ1

6. How confident are you right now that you will complete this program and graduate? CRQ

7. What do you think motivates you most to succeed in college? CRQ

Questions Related to Communication Challenges

8. How do professors differ from one another in their classroom presentations? SQ2

9. What is the most helpful thing you remember a professor doing to help you succeed academically? SQ2

10. Think of a time that you needed help to follow the lesson that was presented in class. Tell me about that in as much detail as you can. SQ1

11. In light of your experience, what could help you understand class assignments? SQ2

Questions Related to Social Interaction

12. Describe your experience in the classroom as a student in STEM. SQ2

13. Please describe your comfort level in class and school in general. Use specific examples to describe your feelings. SQ1

14. How does your experience in the classroom affect your confidence that you will succeed in college? CRQ

15. When completing an assignment with a group or cohort, how do you feel about your place in the group? SQ1

Questions Related to Range of Interests

16. Please describe how specific programs or individuals have helped you in this program. Use specific examples. SQ2

17. What hobbies do you pursue in your free time? SQ2

18. Please describe how your interactions with classmates outside of the classroom affect your opinion about your success in college. SQ1

Additional prompting questions will be used to promote fuller description and to gain further information as the interview reveals new directions for data collection. These may include:

1. You mentioned _____. Could you explain why that is important?
2. Could you describe that in more detail?
3. Could you describe a time when that happened to you?
4. Specifically, how did that affect you?
5. etc.

Questions one through seven serve as introductory questions and help to frame the interview. These questions allow the participant to begin thinking about the personal factors that influence his experience of self-efficacy (Astin, 1999; Bandura, 1986, 2006). The first two are ice-breaker questions to make the participant more comfortable with the interview setting. Questions three and four examine the role of personal choices in self-efficacy (Astin, 1999; Ortiz, 2020; Roberts, 2010; Sarrett, 2017; Seok et al., 2018; White, 2019). Questions five

through seven guide the participant to think about self-efficacy in light of his past experiences and his current mindset (Astin, 1999; Donachie et al., 2017; Sithole et al., 2017; Tinto, 1975; White, 2019). Questions eight through 11 relate to the participant's interaction with the teaching environment and modeled behavior, specifically considering communication challenges often experienced by autistic students. Questions eight and nine lead the participant to consider behaviors and environments that support his self-efficacy (Astin, 1999; Bailey et al., 2019; Caruana et al., 2018; Felege et al., 2018; Gillespie-Lynch et al., 2016; Sarrett, 2017; Seok et al., 2018). Question 10 allows the participant to reflect on environmental or communication issues that hinder his self-efficacy (Caruana et al., 2018; Felege et al., 2018). Question 11 invites the participant to consider his academic environment and agentic responsibility (Donachie et al., 2017; Gillespie-Lynch et al., 2016). Questions 12 through 15 relate to the participant's experience of social interaction as influences of behavioral and environmental facets of learning. Social competency directly impacts self-efficacy. Questions 12 and 13 address the challenges of social interaction for neurodiverse students (Accardo et al., 2019; Howe & Stagg, 2016; Hull et al., 2017; Moseley & Pulvermüller, 2018; White, 2019; Seok et al., 2018). Question 14 allows the participant to focus on the influence of the social experience on his self-efficacy (Howe & Stagg, 2016; Hull et al., 2017; Moseley & Pulvermüller, 2018; Sithole, 2017; Tinto, 1975). Question 15 leads the participant to reflect on the essence of a social learning environment (Astin, 1999; Bailey et al., 2019; Haas et al., 2016; Hull et al., 2017; White, 2019). Questions 16 through 18 relate to environmental and behavioral influences of learning in light of autistic characteristics of a limited range of interests. These questions highlight the outcome expectations of the participant. Question 16 allows the participant to reflect on what he has gained through the interaction with available supports and individuals (Accardo et al., 2019; Donachie et al., 2017; Chiang, 2020; Sarrett, 2017). Question 17 guides the participant to consider the benefits of his

non-academic pursuits (Astin, 1999; Kingsbury et al., 2020); Question 18 leads the participant to describe the influence of his range of interests on his self-efficacy (Astin, 1999; Kingsbury et al., 2020).

Individual Interview Data Analysis Plan

The data analysis for individual interviews followed modified van Kaam guidelines described by Moustakas (1994). These guidelines include the essential elements of *epoché*, horizonalization, reduction and elimination, and imaginative variation.

No data was collected before receipt of IRB approval. Research experts in the field reviewed interview questions before any interviews occurred. The modified Van Kaam method, as described by Moustakas (1994), guided the data analysis. Reduction is the process of identifying the specific material in the collected data that describes the experience being examined. Reduction began with the words of the participants. All interviews were audio recorded and transcribed verbatim. Notes were made following each interview concerning what went well or not well in the interview process, the atmosphere during the conversations, and an impression of the student's openness to participate actively. Notes were taken during focus group meetings and immediately following the meetings.

The first step in reduction is reading and re-reading the interview. Smith (1996) recommends an idiographic approach to analysis, completing one interview analysis before moving on to the next one. The data was *horizonalized* by listing each participant's expression relevant to the experience (Moustakas, 1994). The horizonalized data was then examined for invariant constituents, those expressions that are unique and essential descriptors of the experience. The invariant constituents contribute to the full and specific experience description. Invariant constituents must meet two criteria. First, the idea expressed must be a unique and essential component of the participant's description of their lived experience. Secondly, the

quote must be reducible to a definable meaning which can contribute to the description of the experience. Elements of the data that do not contribute to the description or are repetitive or vague were eliminated (Patton, 2002). Moustakas (1994) suggests intense reflection in this process. The researcher's imagination is engaged to perceive the phenomenon from the participant's perspective. He recommends "keeping our eyes turned to the center of the experience and studying what is just before us, exactly as it appears (Moustakas, 1994. p. 93)". Following horizonalization and the identification of invariant constituents, the researcher began searching for themes. Working with one transcript at a time, constituent quotes were examined for themes. Initial notes reflected the researcher's summarizations, associations, or preliminary interpretations of the interview text. The transcript and initial notes were used to identify emerging themes of experience. These themes were examined for clusters of commonalities or superordinate themes that served as primary themes for other subthemes. This was done with the original transcript to ensure the themes accurately reflect the described experiences. The aim was to create some structure or order from the concepts found in the transcript. The emerging themes were arranged in a table of Subordinate themes and associated subthemes. These themes were used to develop initial individual textural descriptions that rely heavily on verbatim excerpts and quotes from the participant. The analysis was cyclical, returning to the transcripts repeatedly until a final list of themes was developed. The prevalence of these themes and the richness of the descriptions in the interviews impacted the significance of each theme in the research. Clustered themes and meanings were used to develop the textural descriptions of the experience (Moustakas, 1994). This process continued with the following transcript, either by beginning "from scratch" or using the discovered themes to inform the analysis. Smith (1996) suggests that either approach is effective for phenomenological studies.

Moustakas (1994. p. 98) notes that “the task of imaginative variation is to seek possible meanings through the utilization of imagination.” The textual descriptions developed in the reduction process were used to create structural descriptions that examine the participant's emotional and social connections to the phenomena. The structural description aimed to present the participant's experience in a way that describes the irreducible structures—those that must exist for the phenomenon to exist (Moustakas, 1994). The development of the composite description of the phenomenon is described in the Data Synthesis section.

Anecdotal Discussion

Anecdotes are organically presented stories from the participant. Van Manen (1990) noted that anecdotes differ from other data collection forms because they are more closely associated with the participant’s lifeworld than interviews or written surveys. The data arises from the natural perspective of the participant as a co-researcher rather than through the structural lens developed by the researcher (Beedie, 2007). This form of storytelling is a more natural way for a participant to relate their experiences to others (van Manen, 1994). Anecdotes uncover the nuance of the event as the participant describes the emotion and the meaning of the experience. Participants use anecdotes to tell the story of the moment in their own words (Beedie, 2007; Morse, 2006; van Manen, 1994). Unlike interviews, which the researcher frames, anecdotes allow the participant to express his perceptions using words and phrases that most accurately reflect his experience (van Manen, 1990). These stories are grounded in personal experience and encourage reflection on the event (Morse, 2006; Ogueh, 2019). Anecdotal discussions can more accurately depict the true thinking of the participants. They also help the participants to reveal more about their true perceptions and their own character.

Each participant was invited to bring an artifact—a personal possession, a class assignment, a letter from a family member, etc.—to the interview, representing their experience

in higher education. The artifacts were used to elicit anecdotal descriptions from the participants. The researcher asked the participant to describe the artifact and its significance in as much detail as possible. The researcher asked the participant to share a story highlighting the artifact's significance. The anecdote discussion was recorded directly to the researcher's laptop and cell phone using a transcription app. As the participant related the story, the researcher employed prompting questions for fuller descriptions of how the experience relates to the understanding of self-efficacy. In addition to recording the discussion, the researcher took brief notes during the anecdote discussion (Appendix F) on the artifact's significance to the participant as it was being described.

Van Manen (1990) described anecdotes as significant sources of qualitative data. He noted that the process differs from interviews in several ways. First, the anecdotal description is more natural than responses to interview questions. As the participant describes the nature of the artifact and its connection to the experience, the researcher should minimize interruptions. As van Manen noted, "Patience or silence may be a more tactful way of prompting the other to gather recollections and proceed with a story (1990. p. 68) ". The researcher should only prompt the participant with questions to help the participant relate the story to the studied experience. Additionally, anecdotes differ from interviews because the subject matter is in the control of the participant more than the researcher. This distinction will likely come nearer to a complete description of the participant experience. Researchers have discovered that anecdotes reveal aspects of an experience that might otherwise remain concealed (Eifried, 2003; Pitard, 2017). Finally, anecdotes generally carry only a single point of cogency (van Manen, 1990). This point and the contents of the anecdote, which directly relate to that point, are the researcher's goals. Van Manen (1990) cautioned that trimming away extraneous and irrelevant content, however interesting that content might be, is a rigorous task.

Anecdotal Discussion Questions

Because the anecdotal interview is participant-driven, it was impossible to prepare all anecdote questions and prompts before the interview (Van Manen, 1990). The collaboration of the participants determined the participation of the researcher.

Anecdotal Discussion Data Analysis Plan

Van Manen (1990) and Nayar and Stanley (2015) recommend that the analysis of anecdotes generally follows the same procedures as data analysis for interview questions. The data analysis of anecdotal discussions followed modified van Kaam guidelines recommended by Moustakas (1994). These guidelines include the essential elements of *epoché*, horizonalization, reduction and elimination, and imaginative variation. As data collection immediately followed each interview, the ongoing process of *epoché* was essential for unbiased data collection and analysis. The transcripts of the anecdotal stories were horizonalized. The horizonalized data was then examined for invariant constituents, those expressions that are unique and essential descriptors of the experience. The invariant constituents contributed to the full and specific description of the experience itself. Following horizonalization and the identification of invariant constituents, the researcher began searching for themes. Initial notes reflected the researcher's summarizations, associations, or preliminary interpretations of the interview text. The transcript and initial notes were used to identify emerging themes of experience. These themes were used to develop initial individual textural descriptions that rely heavily on verbatim excerpts and quotes from the participant. The analysis was cyclical, returning to the transcripts repeatedly until a final list of themes was developed. The prevalence of these themes and the richness of the descriptions impacted the significance of each theme in the research. Clustered themes and meanings were used to develop the textural descriptions of the experience (Moustakas, 1994). This process continued with the following transcript, either by beginning "from scratch" or by

using the discovered themes to inform the analysis

Focus Groups

In phenomenological research, the primary source of data collection is individual interviews. This research included a focus group format. A focus group is a group of participants selected because they have specific characteristics related to the studied experience (Guest et al., 2013; Patton, 2002; Willis et al., 2009). Patton (2002) suggests that focus groups can help to refine data because the social interactions in a focus group serve as checks and balances to eliminate false or extreme views. The focus group will consist of between six and 12 individuals. In addition to meeting the goals of redundancy and saturation, researchers describe this number as sufficient to obtain social interactions and group dynamics while keeping the size of the group small enough to manage the flow of the conversation (Guest, 2013; Onwuegbuzie et al., 2009; Patton, 2002; Willis et al., 2009). Patton (2002) noted that anonymity is more difficult to ensure in focus groups and that the participants should be so advised. Participants were recruited through an initial letter of invitation (Appendix B) made available to them through their campus support services. The invitation letter included a link to a screening survey (Appendix C) to determine the respondent's qualifications for this study. Qualifying respondents received a consent form (Appendix D). Qualifying respondents received a link to a Zoom meeting via email. The email noted that anonymity is not as certain as with interviews because of the nature of focus groups. The email also included a reminder that participants are free to withdraw from all or part of the study at any time. At the time of the scheduled interview, the researcher and participants joined the Zoom meeting, and the participants were again reminded of their rights regarding the data collected. The focus group was recorded directly on the researcher's laptop and cell phone using a transcription app.

This focus group aimed to accomplish two tasks. First, researchers have noted that autistic students often experience discomfort and anxiety when participating in research (Curtis-Wendlandt & Reynolds, 2020; Webb & Welsh, 2019). The focus group format will ease some of these concerns by allowing the students to participate with their peers. Other researchers have used focus groups to ease the discomfort of research participants for whom communication was challenging. Sosas (2021) used focus groups with participants for whom English was a second language. Thompson et al. (2017) noted that a focus group setting helped trauma survivors overcome their reluctance to communicate. This may result in supplemental data to add to the richness of the interview discussions. Secondly, the group dynamic's social structure can help develop new themes not discovered by the interviews (Creswell & Poth, 2018; Guest, 2013; Roller & Lavrakas, 2015). The focus group interviews centered on themes developed from the individual interviews. Focus group questions were generated from emerging themes and included the following questions:

Focus Group Questions

1. In thinking about our previous discussions, what has occurred to you that you might want to share to add to the information you already shared?
2. Since our discussions began, please describe anything that has happened at school that might illustrate the experiences you have shared with me.
3. What kind of support do you provide each other?
4. How would you describe your social experiences here at school?
5. What do you feel needs to be included in these discussions?
6. What else would you like to share before we conclude?

Focus Group Data Analysis Plan

Focus group data analysis followed modified van Kaam guidelines described by Moustakas (1994). These guidelines include the essential elements of *epoché*, horizonalization, reduction and elimination, and imaginative variation. Data analysis for focus groups differred from other data analyses because of the distinctions of the group dynamic. Focus group discussion can yield qualitative and observational data (Guest, 2013; O.Nyumba et al., 2018). The researcher considered additional data such as participant response or lack of response, the order in which each participant responds, and nonverbal communication (Guest, 2013). The analysis addressed not only the individual statements but also group consensus and the influence of the group dynamic on the individual participants, as well as the emotional and social context of exchanges (Guest, 2013; O.Nyumba et al., 2018; Onwuegbuzie et al., 2009). Willis et al. (2009) noted that the analysis must also consider the discussion intensity and the topics' recurrence. In particular, the discussion was assessed for emotional and interpersonal responses and analysis of statements (O. Nyumba et al., 2018). The transcripts of the focus group discussion were horizonalized. The horizonalized data was then
examined for invariant constituents, those expressions that are unique and essential descriptors of the experience. The invariant constituents contribute to the full and specific description of the experience itself. Following horizonalization and the identification of invariant constituents, the researcher began searching for themes by grouping similar responses. Because of the interactive nature of the focus group, these potential themes must include the context of the group dynamic as a direct influence on the statements of the participants (Guest, 2013; Onwuegbuzie et al., 2009; Willis, 2009). The transcript and initial notes were used to identify emerging themes of experience. These thematic developments should reflect the actual words of the participants as well as the context, intensity, and frequency of those words for each participant and the group (Rabiee, 2004). These themes were used to develop initial individual textural descriptions that

rely heavily on verbatim excerpts and quotes from the participant. The analysis was cyclical, returning to the transcripts repeatedly until a final list of themes was developed. The prevalence of these themes and the richness of the descriptions impacted the significance of each theme in the research. Clustered themes and meanings were used to develop the textural descriptions of the experience (Moustakas, 1994).

Data Synthesis

The synthesis of data began with each interview and artifact anecdote. Data were collected concurrently. After the analysis processes—horizonalization, reduction, elimination, and development of themes—were completed for a participant's interview and anecdote, the discovered themes and recurring ideas were compared for commonalities and expansions of developing themes. Additionally, the researcher carefully considered how the unique point of cogency (van Manen, 1990) revealed in the anecdote clarifies the participant's experience of the phenomenon described in the interview. A composite textual description of these data was developed to describe the intersectionality of the interview themes and the anecdote. The textual descriptions were used to create structural descriptions that examined the emotional and social connections of the participant and the phenomena. The structural description aimed to present the participant's experience in a way that gives the structures of the phenomenon (Moustakas, 1994). The structural description emphasized the words of the participants. This process was repeated for the interview and anecdote of each participant.

Following the development of the structural descriptions, the researcher built a composite textual description incorporating the descriptions of all participants. The composite highlighted the recurring and prominent themes common among the participants. The mixed textual description was used to develop a composite structural description, which examined the

emotional and social connections of the experiences among all the participants. This was a description of typical elements of their experiences.

Roller and Lavrakas (2015) observed that focus groups should be used as something other than a stand-alone research method. Group interviews are used to test emerging themes and to supplement understanding of existing data. Since the focus group interviews centered on themes developed from the individual interviews, the structural descriptions developed from the focus group analysis supplemented the descriptions and themes already developed from the interviews and anecdotes. Describing the emotional and social connections of the participant and the phenomena provided a richer description of the phenomenon's essence (Guest, 2013; Patton, 2002; Roller & Lavrakas, 2015). The structural description emphasized the words of the participants. This structural description incorporated new themes or invariant constituents uncovered through the group dynamic experience.

The researcher described the experience of self-efficacy among autistic students enrolled in STEM programs in a way that reflects the participants' commonalities and unique experiences. The final step in the imaginative variation process was the synthesis of the textual and structural descriptions to provide a rich, thick description of the experience of self-efficacy among autistic students enrolled in a STEM program. The researcher built this narrative description by synthesizing the interview/anecdote composite and the focus group composite. The narrative reflected both the response of the participants and the researcher’s interpretive perspective of the response. Additionally, the research clearly distinguished between these two components (Smith, 1999).

Trustworthiness

Trustworthiness describes the rigorous care the researcher takes to ensure the reliability of findings in qualitative research. Lincoln and Guba (1985) noted that, in qualitative research,

trustworthiness is a subjective estimation that is of primary concern to the research consumer. They recommended a validation standard approximating a counterpart to quantitative research. Qualitative research validation standards consider credibility, transferability, dependability, and confirmability.

Credibility

Credibility assesses the accuracy with which the researcher's findings reflect the events as the participants constructed them (Collier-Reed et al., 2009; Lincoln & Guba, 1985). Credibility was established through (a) triangulation—using multiple sources and means of collecting data on the phenomenon, (b) member checking-verifying accuracy of the thematic development with the interviewed participants, and (c) peer debriefing—review of research procedures and findings by other researchers (Creswell & Creswell, 2018).

Transferability

Transferability describes the likelihood of applicability of the research outcomes to other settings. (Lincoln & Guba, 1985). Lincoln and Guba noted that the original enquirer could not Know the potential sites or means of application to which their research might be employed. Instead, the potential for transferability is enhanced by providing sufficient detail to enable other researchers to determine applicability to other sites or settings. This study highlights the experiences of eleven students in four-year institutions in different geographic and cultural regions of the United States. Detailed, thick descriptions and discussions of the settings and participants improved transferability by allowing the study to be conducted in other settings. The descriptions of research conditions created in this study will enable future researchers to determine the extent of transferability to different settings.

Dependability

Dependability describes the consistency and repeatability of research findings as a product of the research methodology, which can be demonstrated through an effective description of the procedures undertaken for the study (Collier-Reed et al., 2009; Lincoln & Guba, 1985). Dependability affirms the quality and appropriateness of the research approach. To validate the findings, data analysis and the research processes were subjected to an external third-party audit. This inquiry audit will confirm that the procedures are comprehensive enough to allow replication of the research.

Confirmability

Confirmability is a degree of neutrality or the extent to which the respondents shape the findings of a study and not researcher bias, motivation, or interest (Lincoln & Guba, 1985). The researcher aimed to ensure that his findings arose from the data collected. Rich, thick descriptions of themes contributed to confirmability. An audit trail (Appendix H) was used to ensure consistency in the data collection (Creswell & Poth, 2018). The audit trail included descriptions of data sources and collection methods, data analysis products, descriptions of analysis processes, and alterations to the research process (Gall et al., 2007). Triangulation through multiple sources and multiple means of collecting data also strengthened confirmability. The researcher kept a reflexive journal (Appendix G) to describe the researcher's position, assumptions, and orientation regarding the phenomenon (Creswell & Creswell, 2018; Gall et al., 2007).

Ethical Considerations

Ethical considerations were maintained throughout this study to protect the human participants (Moustakas, 1994). No data were collected without IRB approval (Appendix A) from both universities. Participation in the study was voluntary, and informed consent (Appendix D) was a priority. The privacy of the participants was a primary consideration. All data were

secured at all times. Additionally, the institution and participants were assigned pseudonyms for all written records, including this proposal. Patton (2002) noted that anonymity is more difficult to ensure in focus groups. The participants were made aware of this consideration in writing. Throughout the study, participants were reminded that they were free to withdraw from all or part of the study at any time. The study followed a situational ethical perspective (Leavy, 2020), which suggests a moral obligation to listen respectfully to the students without passing judgment and to ensure that all conversations are considered comfortable for the students so that they have positive feelings about their ability to contribute. These considerations were crucial due to the unique communication and interaction challenges faced by many autistic students. All documentation, including consent forms, transcripts, and demographic data, will be kept on a password-protected computer for at least three years (Creswell & Poth, 2018).

Summary

This research aimed to understand the experience of neurodiverse students as they navigate the academic and social climate of higher education in a STEM field. A participant-sensitive approach following the principles of transcendental phenomenology can inform the pedagogical process and support persistence for neurodiverse and neurotypical students alike. This chapter describes the nature of transcendental phenomenology design, which was used in this study. The setting, participants, and procedures were also described. Research questions were presented, and three methods were used for data collection. Analysis procedures following modified van Kaam guidelines recommended by Moustakas (1994) were detailed.

CHAPTER FOUR: FINDINGS

Overview

The focus of this study was to understand the lived experience of autistic students in higher education. This research emphasized what contributed to the self-efficacy perceptions of these students enrolled in STEM programs in four-year universities. Using a transcendental phenomenological approach, the students collaborated as partners in the research by expressing their lived experiences directly during semi-structured interviews, anecdotes, and focus group discussions. Foregrounding the voices of the participants, data were collected through in-depth interviews (I), anecdotal discussions (A), and focus group discussions (F). Data were analyzed using thematic analysis. The analysis aimed to identify common themes and patterns in the participants' narratives, shedding light on the unique challenges and strengths of autistic college students in STEM disciplines. Even though this study focused specifically on the self-efficacy perceptions of autistic students, this study can potentially be relevant to other experiences of neurodiverse students in higher education.

Participants

This study consisted of eleven undergraduate college students ranging from sophomore to senior status (Table 1). Participants consisted of six male and five female students ranging in age from 19 to 25 years old who have a diagnosis of an Autism Spectrum Condition. Nine of the eleven students participating have two or more diagnosed disabilities, including ADHD, mood disorders, hearing impairment, digestive health issues, and poor eyesight. Five indicated that they take medication or receive regular counseling support for their co-occurring conditions. Their academic majors included computer science, medicine, and engineering, ensuring representation from various STEM fields. Five students are African American, four are Caucasian, one is Asian

American, and one is Latino. Three are first-generation American citizens born to emigrants. All students were currently enrolled in STEM programs at the universities where the study was conducted. These students were all willing to disclose their lived experiences, self-advocate, and use their voices to address stereotypical perceptions of students with ASC. Additionally, they were ready to share their personal opinions and feelings about their academic and social experiences on campus.

Table 1

Participant Demographics

Name	Gender	Age	Race	School	School Year	Major	Age at Diagnosis
Capy	M	23	Asian American	Engineering	Senior	Data Science	21
David	M	21	Caucasian	Engineering	Junior	Civil Engineering	3
Aaliyah	F	25	African American	Engineering	Sophomore	Civil Engineering	12
Lucy	F	24	African American	Engineering	Sophomore	Electrical Engineering	15
Galaxy	F	21	Caucasian	Engineering	Senior	Computer Science	20
Alexie	F	25	African American	Engineering	Sophomore	Electrical Engineering	12
Harry	M	23	African American	Engineering	Sophomore	Civil Engineering	5
Kelly	F	23	African American	Engineering	Sophomore	Environmental Engineering	12
Andy	M	24	Caucasian	Engineering	Junior	Electrical Engineering	9
Robot	M	26	Caucasian	Engineering	Senior	Engineering Physics	16
Zero	M	21	Latino American	Medicine	Sophomore	Neuro Science	5

The interviews took place via Zoom video conferencing using the interview questions in Appendix F. The initial interview included time for anecdotal discussions. The video conferences were recorded while transcription took place via Zoom captions and on a second device using

Google Voice to Text. Following each interview, recordings were re-played and compared with the transcriptions, corrections were made to any errors, and irrelevant conversations or repetitive transition words were removed in preparation for text analysis. Once the interviews were transcribed correctly, the videos were deleted, and transcriptions were saved on a password-protected computer. The following are summaries of each of the eleven participants using pseudonyms to protect the privacy of the participants. Each participant chose a pseudonym. They are listed in the order in which the interviews were conducted.

Capy

Capy is a 23-year-old Asian American male living on the East Coast. His parents are from China, and he was born in Japan before his family immigrated to the United States. He spent his childhood on the West Coast, and his family moved to the East Coast when he began middle school. He has a brother who was diagnosed as autistic at the age of three, but his own ASC diagnosis did not occur until he was 21. Capy's interview was conducted via Zoom. He was alone in his room on campus when the interview took place and was comfortable answering questions and relating personal experiences. Capy is academically successful and very confident in his academic future. He attended a high school that he described as "very rigorous"(I). He has interests outside of the classroom but does not feel any need for social experiences. He has friends whom he meets regularly for activities, but his favorite recreational pastime is reading academic articles.

David

David is a 21-year-old Caucasian male from the East Coast. He attended a large public high school and decided to enroll in a university farther from home than he had previously traveled. David was diagnosed with ASC when he was very young and was also recently diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) in college. David's interview

was conducted via Zoom. He was alone in his room on campus when the interview took place and was comfortable answering questions and relating personal experiences. David is academically successful, although he considers himself slow compared to his classmates. He has struggled to make friends and does not feel close to anyone on campus. His parents are very supportive of his decision to pursue an education in STEM. He noted, "Everybody just knew I wanted to go to college."(I) He chose this college specifically because of its engineering programs and admits that he did not know much about the institution when he enrolled. He encountered academic and social challenges right away during his first year. He has attempted to get involved on campus but is uncomfortable in large social settings. David has only interacted with support services since he was diagnosed with ADHD, although his ASC diagnosis is on file. He is happy with his academic and personal progress in college.

Aaliyah

Aaliyah describes herself as a shy advocate. She lives with this continual contradiction. She says:

> You have to have that kind of mindset that you have to make it happen for you no matter what, and also, there are some who have a kind of victim mentality that is always there. I am really trying to deal with that. I don't want to be a victim of circumstances. I want to make myself proud. I want to advocate for myself (A).

She is 25 years old, and her parents are immigrants from Kenya and South Africa. She has spent her entire life in the state in the Northeast where she was born. She comes from an urban area and attends a large public university. Aaliyah's interview was conducted via Zoom. She was in her apartment with some family members present for support. She chose to keep her video turned off during the interview.

Lucy

Lucy is a 24-year-old African American female born on the West Coast and has lived there almost all her life. She has siblings, but she is the only member of her family with a diagnosis of autism. She excelled at mathematics and physics in high school. While in high school, she heard about electrical engineering and began investigating the field. “I liked it, and it seemed to fit me. I thought, you know, maybe I’m good at this” (I). Diagnosed with ASC as a teenager, Lucy described her parents as “very understanding and very supportive” (I). She said they helped prepare her for the demands of college by teaching her to be independent and to speak up for herself. When she left for college, her mother gave her a clock to remind her that she was responsible for managing her time well. “It was a symbol of my independence and responsibility. I still look at the clock and remember that she believes in me” (A).

Galaxy

> Galaxy got a head start on his plans to study computer science. He noted:
>
> I attended a high school where computer science classes were readily available. I think it fits very well with my like methodical, logical kind of thinking and I had an advisor in high school that really supported me to do well in computer science, so I did it for all four years (I).

He has only recently received a diagnosis of ASC and ADHD. He is still adjusting to the significance of this news. He noted that it helped explain a lot to himself and those who know him. A Senior and a computer science major, Galaxy plans to be a college professor one day. He has spent his summers with inner-city groups teaching robotics to children. Galaxy’s Zoom interview took place in his dorm room. He was comfortable describing his experiences and passionate about advocating for the needs of autistic students.

Alexie

Alexie is a 25-year-old African American female born on the East Coast and has lived there almost all her life. She has an older sister, but she is the only member of her family with a diagnosis of autism. She excelled at mathematics and physics in high school. She was 14 when she was diagnosed as autistic. She also has a mood disorder, slight hearing impairment, and poor eyesight. Education has always been challenging for her. She said, " It hasn't been easy. My parents had to take a lot of time for me, to care for me, to offer moral support. It's just a lot" (I). Alexie participated in a Zoom interview. She spoke the least of all participants. The interview experience was more challenging for her than for the others. She was most animated when speaking of the support she has received from family and friends.

Harry

Harry has always loved science and mathematics. He knew from a young age that he would pursue a STEM major. "This is what I always wanted" (I) was his summation of his path from childhood to higher education. Harry is 23 and was diagnosed as autistic at the age of 5. He and his family are from New England, and until he enrolled in college, he had never traveled outside of his home state except to visit relatives briefly. Higher education was a radical experience for him in almost every part of his life. He said, "I had to completely change my way of thinking. I had to learn how to be around strangers, how to make friends, and how to live my life" (F). Harry's interview was conducted via Zoom while he was in his room on campus. He was comfortable sharing his experiences in STEM and as an autistic sophomore on a large college campus.

Kelly

Kelly is a 23-year-old sophomore female who describes the challenge of autism as "continually trying to fit in and learning to advocate" (I). Kelly is learning to play pool, but she noted that her academic success in engineering has not really helped to improve her game. "That

only comes with practice" (I). College was a refreshing change for her. Kelly was one of the very few minority students in a predominantly white high school. Autism and ethnicity were continual reminders that she was different. Attending a large university introduced her to a spectrum of people from differing backgrounds and experiences. "It was like, they were all different too but in different ways. I began to think that maybe I fit in after all" (I).

Andy

Andy is a 24-year-old Caucasian male who was diagnosed as autistic at the age of nine. His family is from the West Coast, but after his parents separated in his early childhood, he moved with his mother to the Midwest. He described his childhood as lonely and demanding. He observed that "it was like I had to like maneuver most of the things by myself because I felt like (my parents) were really busy tackling their own issues" (I). He often feels overwhelmed by the higher education environment, especially in a large institution with large classes. "I feel like I am struggling to be seen and to be heard. At the same time, I am really uncomfortable when attention is on me" (F). Andy's interview took place in his dorm room at his college. He was not at ease answering interview questions, but he twice remarked that talking about his experiences was important.

Robot

Robot's pseudonym reflects his passion for robotics. A student of mechanical engineering and engineering physics, Robot hopes to be a teacher soon. He is 26 years old and was diagnosed in high school with autism and, more recently, with ADHD. He also deals with depression and mood disorders as well as other medical conditions, which he primarily addresses with medication. "I have to take a lot of pills every day so things don't get really bad for me" (I). He has struggled to pursue higher education while facing all of the health challenges, but he says, "Although I struggle a lot, I am very fortunate to have a lot of supports around me that allows me

to succeed in what I'm doing. I think that's the only reason I've always succeeded" (I). Robot was interviewed via Zoom in his dorm room. He was quite willing to participate but noted that he was not comfortable immediately answering questions. He said, "I always prefer to think about it for a while before I answer a question" (I).

Zero

Zero is a 21-year-old Latino male from the Southwest. He comes from a highly educated family who emigrated to the United States from Peru. After his parents were naturalized, Zero was born in the Southwest. Although he has never lived anywhere else, he has traveled outside of the U. S. to visit Peru and as a foreign exchange student as well. He was diagnosed as autistic at the age of five and later received an additional diagnosis of ADHD. He also has a significant sleep disorder. Zero's interview was conducted via Zoom. He was alone in his room at home, where he lives with his parents. "That's changing next semester when I move on campus. I'm kind of nervous about that" (I). Zero is academically successful in his STEM pursuits but struggles with history and writing classes. He is still in touch with two friends from middle school but does not really have any friends on campus. Zero has been instrumental in promoting appropriate support for autistic students on his campus.

Results

The thematic analysis of the participants' narratives revealed several key themes that are central to the experiences of autistic college STEM students. These themes are presented below. The findings from this phenomenological study provide valuable insights into the experiences of autistic college STEM students. The identified themes (Table 2) highlight the multifaceted challenges these students encounter within the academic and social realms of college life. Understanding these experiences is crucial for developing targeted interventions and support

systems that can enhance the well-being and success of autistic college students pursuing STEM majors.

Table 2

Identified Themes

Theme	Subtheme 1	Subtheme 2	Subtheme 3
Adapting to the Academic Environment	Executive Function	Environmental Structure	
Coping Strategies	Isolation	Special Interests	Support Groups
Fitting In	Friendships	Masking	Loneliness

Challenges of Adapting to the Academic Environment

Participants were asked several questions regarding their life at college and the adjustments that they experienced after enrolling. The majority of the participants indicated that they had struggled to adjust to their new environment when they began their higher education experiences. Galaxy noted, "I had never lived anywhere but home before I went to college. I didn't know what to expect" (I). Capy said, "I had never eaten in a cafeteria. I didn't even recognize most of the food" (I). Almost all of the participants reported challenges with executive function issues and with the physical environment of the classroom and campus.

Executive Function

Executive function challenges often encompass a range of cognitive processes that are essential for goal-directed behaviors, such as planning, organizing, initiating tasks, shifting between activities, and self-monitoring. Several students reported that they struggled with time management, a critical aspect of academic success. Time management issues included planning and organization of daily responsibilities, shifting between tasks, and adapting to unexpected

changes. For most of the participants, living independently was a new experience. Lucy noted that “ordinary things like setting an alarm or making sure I have clean clothes” (A) were new skills that required a great deal of effort. Aaliyah echoed this idea when she acknowledged, “ I still don’t cook much. I can’t seem to find the time” (I). Alexie echoed these sentiments. “There is so much to do. I never know how to get started. My friends help me stay on track with assignments. They help me get to class on time and make a budget, things like that” (F).

Seven of the participants reported struggling with decision-making. Andy noted “There are so many things to remember to do every day. It’s hard to know what to do next” (I). Their challenges with decision-making may not always have been a result of autism. Kelly said, “ I was guided to this school by my parents and my uncle. I always ate what my mother made to eat. I had never really had to decide anything before college. I guess I didn’t know how” (I).

Environmental Structure

Autistic college students often encounter a unique set of challenges related to their sensory processing and environmental sensitivities. These challenges included difficulties with typical classroom procedures and sensory sensitivities that could disrupt their focus during lectures or lab work. Almost all of the participants cited classroom noise as stressful. The sensory input from multiple conversations, background noise, and the need to navigate complex social cues can cause anxiety and exhaustion. Additionally, Galaxy stated, “Fluorescent lights kill me” (F)! David said, “Sometimes, I can feel the lights. It’s awful” (I). Participants frequently discussed the importance of having access to academic accommodations and supportive faculty to help them succeed. Seven of the participants acknowledged trouble with lighting in classrooms. Zero has minor problems with lighting but noted, “Sound. Certain sounds sometimes just trigger me. It takes a lot to come back from that. And touch, too. Certain touches like certain fabrics I will not wear or touch” (I).

The classroom process itself proved daunting for many participants. They noted that they were reluctant to ask questions in class, participate in group discussions, or seek help from professors when needed, potentially impacting their academic performance. Aaliyah said, “Group assignments are loud. That’s a problem for me” (I). Capy also struggled with group settings. “I don’t understand the jokes or the expressions. By the time I realize that someone is being sarcastic, I am already behind in the assignment” (I).

Coping Strategies

Coping strategies are essential for autistic students in higher education, as they often face unique challenges related to sensory sensitivities, social interactions, and executive functioning. Coping strategies of autistic students in higher education encompass a range of approaches, from seeking structure and social support to self-advocacy and academic accommodations. The participants in this study described various approaches to dealing with the stress and anxiety that they experience as a part of higher education. These approaches included isolation, pursuing special interests, and seeking support from family and peers.

Isolation as Stress Relief

Many participants described a preference for solitude as a coping strategy for sensory regulation. They explained how the sensory overload experienced in crowded lecture halls or noisy labs was mitigated by retreating to quieter spaces. Lucy shared, "I just try to find a quiet corner in the library or my dorm to study. It helps me focus and keeps me from being overwhelmed” (I). Galaxy noted that things had significantly improved “since they moved me into the quiet dorm. Nobody knows anybody here” (I). Galaxy also noted, “I spend a lot of time just being lonely. I want to be around other people, but it’s so stressful, I can’t take it” (F).

Special Interests as a Form of Stress Relief

Capy likes rock climbing. Galaxy solves Rubik's Cubes. Harry enjoys Billiards. Several participants noted that they had particular interests or hobbies that helped them deal with the challenges of campus life or academic demands. David shared, "Sometimes I like to go swimming. It's like a break from all of the noise" (I). Many participants expressed a passion for their STEM field, impacting their unique interest endeavors. Although he enjoys rock climbing and Frisbee golf, Capy stated, "My favorite thing to do in my spare time is reading scholarly research articles" (I).

Support as Stress Relief

Although the participants in this study all attend universities with adequate support services, most seek information and encouragement from other sources. The students reported that they most often rely on their parents and online social groups as vital sources of support in their academic and personal lives. Lucy said, "I talk with autistic students online to learn how to make a schedule for things or to ask about the best way to do a project" (I). She added, "My online friends and my parents encourage me a lot" (I). Harry noted, "I wouldn't have made it this far without my parents' guidance. They keep me going" (A). Galaxy said, " I am part of several online awareness groups for autism. I've never met anyone. Some of them are in different countries. We learn from each other" (A).

Fitting In

Many students invest much of their college experience in discovering their identity. As they learn independence and gain new experiences, they may struggle with discovering where they fit in socially and academically. The participants in this study described the experience of fitting in through the lenses of friendship and masking.

Friendships and Social Integration

Participants were asked several questions about their social experiences on campus. They also shared anecdotes that described their own experiences. The college offers opportunities for meeting a diverse range of people who share common interests and goals. This was an eye-opening experience for Kelly, who said she had always struggled to find a way to fit in. Her college experience has provided a chance to connect with people with perspectives and experiences as unique as hers. Aaliyah feels that she would be more successful in her college experience if she could learn to interact more. She noted, " People say, 'This is my best friend.' I have never had that" (I). For Capy, friendship was an experience he did not have until junior high school. "The kids in elementary school always thought I was kinda creepy because I remembered everything and don't get jokes. My friends help me to understand how to act, and they even explain jokes and songs to me" (I). Lucy said, "I have colleagues and online friends that let me ask questions about how to deal with situations" (F).

Masking and Social Integration

Masking involves consciously or unconsciously concealing one's autistic traits or behaviors to fit in and conform to societal or social expectations. Galaxy said, "When I'm in class, I spend more time thinking about not stimming than I do listening" (I). In college, where social integration and forming connections are essential, many autistic students feel compelled to engage in masking to varying degrees. Masking can be a coping mechanism for autistic students in college. Alexie said, "I mask sometimes just so people won't keep looking at me" (I). Some autistic students mimic neurotypical behaviors, such as maintaining eye contact, imitating social expressions, or suppressing sensory sensitivities to blend in better, avoid potential judgment, or make interactions more manageable to navigate. Capy observed, "Every conversation involves masking or covering up in some way" (I).

Masking can be physically and mentally exhausting, leading to a sense of constant

vigilance and anxiety as students work to hide their true selves. While it may help them navigate social situations more smoothly, it often comes at the cost of their authenticity and can contribute to mental health challenges. Capy explained that

> Any time I have an assignment or a presentation, the whole thing is scripted. I even practice changing my tone or my volume to sound more like everyone else. People say I would be a good teacher, but I would hate it. I am always exhausted after I finish (A).

Some autistic students may struggle with a sense of identity and authenticity, feeling as though they are playing a role rather than being themselves. Zero said, "I learned from a book about how to show the right expressions and stuff around others. I'm always faking it (I)." This internal conflict can be emotionally taxing and impact their overall college experience.

Research Question Responses

The themes described by the participants directly inform the research questions. Through their responses, participants enlightened the researcher concerning their perceptions of self-efficacy, social integration, and the supports that are available to the participants.

Central Research Question

What are the self-efficacy experiences of neurodiverse students currently enrolled in a STEM program at four-year institutions in the United States? Six participants indicated that they are confident in their ability to complete their STEM program degrees. Four expressed some reservations, and another participant is considering changing their major. Those students who expressed confidence ascribe their self-efficacy to internal motivation or their personal support. David said, "I always knew I would finish (I)." Aaliyah was motivated by her uncle. "He is an engineer, and he encourages me a lot. When I need some help, I talk to him" (A). Harry said, "I am motivated by autism. I want others to see that your condition doesn't matter. If you are given a chance, take it" (I). Students with self-confidence and a strong support network of peers who

understand their unique challenges and strengths are likelier to develop a sense of self-efficacy in STEM fields.

Those with reservations noted challenges with transition to higher education or difficulties with classroom experiences. Lucy observed, “I have professors that seem frustrated if they have to change anything for a student” (F). Galaxy is considering a change in major precisely due to a lack of support and accommodation in his current field of study. He said, “ I am a senior, but I do not get any support from my department. All of my support actually comes from faculty in the Education department. It’s a little depressing” (I).

Sub-Question One

How do autistic students in STEM-related fields of study experience the social campus environment? Autistic college students often face unique social interaction challenges that significantly impact their academic experience and overall well-being. David said, “So many people just don’t have to deal with the real world the way I do” (I). Participants described challenges that stem from difficulties in communication or understanding social cues. Interpreting nonverbal cues, such as facial expressions and body language, can be difficult for those on the autism spectrum. Lucy observed that she experiences almost no social challenges in relating to others who are autistic. “I don’t think I could be close to someone who doesn’t have these experiences (I).” Capy shared a similar idea about friendships with neurotypical people. He noted, “I have to always be conscious that they don’t experience the world the way I do. I have to accommodate that all of the time. It can be tiring (I).” Most participants noted they were not greatly interested in pursuing greater social integration. They preferred to be alone or with those few individuals who did not excessively tax their social limits.

Sub-Question Two

How do autistic students in STEM-related fields of study perceive the academic supports

and accommodations that they receive? Autistic students often rely on their parents and online social groups as vital sources of support in their academic and personal lives. Most participants reported that the combined support from families and online social groups offers them a support system that addresses their emotional, educational, and social needs. This network helps them navigate the complexities of college life, build essential life skills, and cultivate a sense of community and acceptance that contributes to their academic success and overall well-being. Five participants stated that they requested some support from the institutions in which they were enrolled. Aaliyah said she sought counseling through her school's support services early in her college experience to learn about scheduling and some issues with living independently. She noted, "I just didn't know how to get started. There was so much I didn't know" (F). Lucy, Galaxy, and Andy have each asked for additional time for testing. Lucy said, "Some professors are really put out when you ask like it is an inconvenience for them" (I). Harry has asked for tutoring support twice, once following an extended illness. He said his professors "were really helpful in getting me back up to speed" (F). Robot acknowledged, "I have to have support. I'm on several medications, and I have issues with autism and physical things, too. I'm online with student services two or three times a week" (I). Most of the participants said that they relied more on family and peers than on the services offered by the institutions. Two participants were not clear about what support services, if any, were provided by their school.

Summary

The eleven students who participated in this study shared experiences that revealed significant themes relating to adapting to the academic environment, coping strategies for dealing with the stress of higher education, and their perceptions of fitting in as autistic students in a neurotypical world. The educational environment creates a host of challenges for autistic students. In addition to the nuances of various classroom presentations, many are also trying to

address sensitivity to sensory stimuli, such as noise, bright lights, or certain textures. Autistic students may need accommodations such as extended time for exams, preferential seating, or access to quiet spaces for studying. The participants described coping strategies that they developed, including isolation, pursuing special interests, and gathering support from family and friends. Many of the participants noted the value of their online support networks. Attempting to fit into the environment of higher education usually involves some degree of masking by concealing behaviors such as stimming or by imitating the behavior of others. The participants describe the experience of masking as exhausting. In their interviews, the participants made no real distinction between academic settings and social ones. For them, almost every form of interaction is a social challenge. Their experiences informed the research questions regarding self-efficacy, social integration, and available support in higher education. Understanding the impact of internal and external motivating factors is essential for educators and institutions seeking to create more inclusive and supportive environments for autistic students. These findings underscore the importance of accessible and inclusive learning environments in promoting the self-efficacy of autistic students pursuing STEM degrees.

CHAPTER FIVE: CONCLUSION

Overview

The purpose of this transcendental phenomenological study was to describe the self-efficacy experiences of eleven students enrolled in higher education STEM programs. The data obtained for this study were collected through personal interviews, anecdotal discussions, and a focus group interview. The thematic analysis of the data revealed several commonalities. This chapter will begin with a summary of the findings, followed by a discussion of how the data analysis relates to policies and practices in higher education. I then discuss the theoretical and empirical implications of the study. The chapter includes a description of the limitations and delimitations of the study and recommendations for future research. The chapter closes with a conclusion.

Discussion

Bandura asserted that the dynamic interaction between personal factors, behavioral patterns, and environmental influences influenced learning. This triad frames the description of the experiences of these eleven autistic participants. Their voices highlight the importance of understanding the cognitive process through the unique lens of autism. Additionally, this description demonstrates that there is no single description of the autistic experience. These participants share commonalities and distinctions, which must be recognized in any complete description of their experiences.

The self-efficacy experiences of autistic students in higher education STEM programs can be empowering and challenging. Autistic students with higher self-efficacy tend to engage more actively in their academic pursuits, demonstrate greater resilience, and experience fewer barriers in their learning process (Ortiz, 2020; Wood, 2020). Higher self-efficacy fosters a sense of confidence, which is pivotal for these students as they navigate the often overwhelming social

and academic landscape of college life. Many autistic students in STEM programs report strong self-efficacy regarding their intellectual abilities. They usually have a deep passion for their chosen field and may possess exceptional attention to detail, pattern recognition skills, and the ability to focus intensely on complex problems. This self-efficacy can propel them to excel in their coursework and research, as they feel confident in their ability to tackle the intellectual challenges of STEM subjects.

The experience of self-efficacy is a product of internal and external influences. Autistic students have reported challenges associated with both of these influences in higher education STEM programs. These challenges can include difficulties with social interactions, sensory sensitivities, and executive function impairments, which may impact their ability to navigate the academic environment effectively. As a result, many autistic students may experience self-doubt and question their capabilities. They may compare themselves to their neurotypical peers and feel that they are at a disadvantage, leading to lower self-efficacy beliefs in their academic pursuits. Some may struggle with self-doubt and anxiety related to social interactions and group work. Group projects, a common component of STEM programs, can be particularly anxiety-inducing for autistic students, as they may fear being misunderstood or face difficulties in navigating the social dynamics of teamwork. These challenges in the social realm can undermine their overall self-efficacy, impacting their confidence in non-academic aspects of their STEM education.

Summary of Thematic Findings

The thematic analysis of the participants' narratives revealed several key themes that are central to the experiences of autistic college STEM students. The participants painted a portrait of an experience that differed not only from their non-autistic classmates but from one another as well. The identified themes (Table 3) included adapting to the academic environment, coping

strategies in educational and social life, and discovering how to fit into the world of higher education. These experiences directly impact the self-efficacy of autistic students as they navigate college life and enter the larger world of independent living. A better understanding of these experiences will aid in developing helpful interventions and support systems that can enhance the well-being and success of autistic college students pursuing STEM majors.

Adapting to the Academic Environment

The majority of the participants indicated that they had struggled to adjust to their new environment when they began their higher education experiences. Almost all of the participants reported challenges with executive function issues and with the physical environment of the classroom and campus. Several students noted that they struggled with time management issues like planning and organization of daily responsibilities, shifting between tasks, and adapting to unexpected changes. Almost all of the participants cited classroom noise as stressful. The sensory input from multiple conversations, background noise, and the need to navigate complex social cues can cause anxiety and exhaustion. Additionally, several participants noted problems with the lighting or visibility in the classrooms and laboratories.

Coping Strategies

Coping strategies are essential for autistic students in higher education, as they often face unique challenges related to sensory sensitivities, social interactions, and executive functioning. The participants in this study described various approaches to dealing with the stress and anxiety that they experience as a part of higher education. These approaches included isolation, pursuing special interests, and seeking support from family and peers. Many participants described a preference for solitude as a coping strategy for sensory regulation. They explained how the sensory overload experienced in crowded lecture halls or noisy labs was mitigated by retreating to quieter spaces. Several participants noted that they had particular interests or hobbies that

helped them deal with the challenges of campus life or academic demands. Recreational activities set on a schedule with a consistent group of peers and friends were helpful in reducing stressful experiences. The students reported that they most often rely on their parents and online social groups as vital sources of support in their academic and personal lives.

Fitting In

As autistic students learn independence and gain new experiences, they may struggle with discovering where they fit in socially and academically. The participants in this study described the experience of fitting in through the lenses of friendship and masking. The participants indicated that they struggle to find a way to fit into the college experience. Interaction is often challenging, and friendships are difficult to cultivate. Although most of the participants have friends from middle school or high school, few indicated that they had made new friends at college. In most social situations, autistic students report that a great deal of effort is invested in masking—concealing autistic traits or mimicking typical social behaviors—in order to fit in better. The participants agree that such efforts are mentally, physically, and emotionally draining. Masking also causes autistic students to struggle with their sense of identity and authenticity.

Higher Education and the Autistic Student

Several factors may influence how autistic students perceive the world of higher education. Some prominent factors are the physical environment, academic expectations, available support, and the campus atmosphere. The perspective created by the higher education campus is also influenced by the preconceptions of the autistic students, their personal beliefs, the influence of peers and family, and other less tangible factors that shaped their thinking long before they arrived at college. To some degree, each of the participants expressed concerns about these factors.

It is important to remember that autism is a way of processing information and experiences rather than a radical difference of being. The participants in this study have aspirations, desires, and challenges that mirror those with more neurotypical experiences. Robot wants to be a teacher. Capy, Aaliyah, and Galaxy routinely advocate for the needs of other students. Andy had a girlfriend. Galaxy and Zero studied abroad for a semester. Zero is constantly worried about being late for class. Kelly struggled with racism on her high school campus. These participants are the portrait of typical college students trying to navigate the experience of higher education.

The self-efficacy experiences of autistic students in higher education STEM programs are shaped by a complex interplay of their academic strengths, social challenges, and the support systems available to them, coupled with their perception of their identity. Building a positive self-efficacy mindset, providing inclusive and accommodating learning environments, and fostering self-advocacy skills are critical factors in helping autistic students thrive in STEM disciplines and realize their full potential. The participants in this study revealed a self-efficacy mindset that is essentially guided by four influences: personal identity (how I see myself), personal development (how I got here), personal experiences (how life is different for me), and personal space (how I fit in).

How I See Myself

The process of self-discovery and acceptance can be complex for autistic individuals as they navigate their unique strengths and challenges in light of their own growing understanding of autism. The perception of higher education by autistic students can vary widely based on individual experiences, strengths, and challenges associated with ASC. The participants in this study shared their understanding of the experience of autism. All eleven of them have invested in some degree of research and exchange regarding their experiences on the spectrum. Their

conversations involve the language of the ASC culture. Words like neurodiversity, scaffolding, heterogeneity, and stigma appear in their interviews. They participate in online autism communities and personal studies. Their voices are essential for a rich portrait of their experiences in higher education.

Many of the participants in this study viewed autism as a different but normal way of processing information and dealing with social experiences. Galaxy is a strong advocate for this perspective. He advocates for changing approaches in the classroom and the medical descriptions regarding autism. “Well, what about if we support people for being people, and instead of saying that they have a deficit, maybe they have a difference or a unique way of doing something” (I). Aayliah supports this idea, saying, “If I had the power, I would tell everyone about autism. Your child is normal. It’s okay, you just don’t understand” (I) Three participants—David, Alexie, and Robot—describe autism as more akin to a disability. David said, “I see my disability as something I accept because I have to; I try to make peace with it, sort of. But I don't like being autistic” (A). Robot shared a similar thought, “I don’t agree with all the positives of autism that people talk about. There aren’t any for me. Without the scaffolding of support and medication, I fall apart” (I). While the concept of neurodiversity has gained recognition and acceptance as a means of celebrating neurological differences and challenging the disability stigma of autism and other neurodevelopmental conditions, some autistic individuals object to the label for various reasons. One primary concern revolves around the heterogeneity within the autism spectrum. Alexie noted the exclusionary nature of many discussions about autism. “It's great that autism is being talked about more, but a lot of people, on benefits, housebound, isolated from the world, are excluded from the conversation. We usually only hear about the success stories” (F).

Some critics suggest that using a single term, such as neurodiversity, may oversimplify the diverse challenges and experiences faced by individuals with autism. They highlight the

differences in cognitive abilities, communication styles, and sensory sensitivities among autistic individuals, suggesting that a single label may not capture the nuances of ASC. Galaxy talked about a phenomenon known as thin-slice judgment:

> That's where you decide on someone based on a very small part of their life that you have seen. That's what happens with autistic people in research because so much of the autistic population is left out of research. There's no way you can understand autism if you only talk to the high-functioning autistic (I).

Additionally, some are concerned that the socially conscious neurodiversity movement could eclipse the actual difficulties and impairments that some autistic individuals face. The autistic population has more than double the mortality rate and significantly shorter life expectancy than the general population (Hirvikoski et al., 2016; Mason et al., 2019). Critics argue that emphasizing neurodiversity exclusively may neglect the need for targeted interventions and support services that address these specific challenges, potentially hindering access to essential resources for some individuals (Gillespie-Lynch et al., 2015).

The experience of autistic individuals may also be characterized by intense focus and deep interest in specific subjects or activities. Both Capy and Galaxy spend personal time reading scholarly journal articles. Capy said, "When I find out about a new thing, I need to learn all I can about it. Sometimes I get caught up for a long time just studying one thing" (I). Galaxy echoed these sentiments. "When I was diagnosed, I started reading every journal I could find about accessibility issues for neurodiverse students. That's just how I am with new things" (I). This can lead to the development of exceptional skills and talents in areas of passion. They may also struggle with tasks that do not align with their interests or sensory sensitivities, potentially affecting their overall well-being.

Repetitive behaviors, often called stimming, are another psychological aspect of autism. These behaviors can include repetitive movements like hand-flapping or rocking, as well as repetitive verbal utterances. Stimming is usually a form of self-regulation and sensory stimulation. Galaxy almost always has a Rubik's Cube in her hand. Robot is usually carrying a soft drink. Zero repeatedly performs hand movements while talking to people. He said, "The only time I'm really aware of it is when I see it, like on a Zoom call" (I). While these behaviors can help autistic individuals cope with sensory and emotional challenges, they may also draw unwanted attention and create social challenges.

Many autistic individuals have intense and focused special interests. These interests can be psychologically enriching, providing a sense of purpose and identity. Autistic individuals may develop deep expertise in their chosen topics, often showcasing exceptional talents and skills in these areas. These special interests can be a source of psychological comfort and personal growth. Capy never stops learning. From childhood, his brain automatically absorbed as much information as possible. To enter a new environment was to be instantly confronted with vast amounts of collectible data. "I memorized things: scripts from entire movies, the exact way that objects are placed in a room, or the pattern of a specific curtain. I used to think that everybody experienced the world in that way" (I). Such natural tendencies have taken a toll on Capy. Although, as an adult, he recognizes the experience and has developed emotional resources to cope with the phenomenon, his memories of childhood are distinctly marked by this tendency.

How I Got Here

Many autistic individuals recognize that their early experiences shaped their perspective of autism. Autistic individuals' understanding of autism is often profoundly influenced by early interactions with family members, peers, educators, and society in general. In his description of those formative years, Capy remarked:

> I perceive my childhood as the worst part of my life. Everything just seemed chaotic. Just going to the grocery store when I was a child was hard because everything was new. I would just take in more information and input than other people. I was always overwhelmed (I).

Galaxy echoed the challenges of information overload, saying, “Every time I walk into a room or meet a new person or see someone again, my brain just collects tons of information, and it is still hard to separate what matters and what doesn’t” (I). These formative experiences contribute to shaping their self-perception, awareness of their own identity, and coping mechanisms. Andy described the experience of his parent's divorce when he was a child:

> I had a kind of bad experience growing up. There was a lot of back and forth with my parents. At times, we were together, and other times, we were not. There were changes all of the time. Every change made it harder for me. I still don’t handle new things well. As a child, I was miserable. And it was like I had to maneuver most of the things by myself because I felt like they were really busy (I).

Early social interactions have a lasting impact on the perspectives of autistic individuals. Positive experiences, such as supportive friendships and family relationships, can foster a positive perception of autism. Negative social encounters such as bullying or rejection may lead to internalized stigma and a less favorable view of their neurodivergent identity. This was Harry’s experience, and he has struggled to overcome it. As an anecdotal illustration, he brought a small trash can with him to his interview. He said:

> Everyone used to say I was useless, that I was trash. I believed it for a long time, and I have carried that feeling with me. About a year ago, things changed. I decided to put all of the negatives in here (the trash can). It doesn’t matter to me anymore. I realized I was enough. I can do this (A).

The moments when individuals first begin to suspect that they might be autistic can be a demanding journey for the individuals and their families. The experiences of autistic individuals and their families when they first begin to suspect that they might be autistic are often characterized by a range of emotions and challenges. Harry said, “My aunt suspected I might be autistic when I was a kid because I was so sensitive to touch. No one was ever allowed to touch me. I’d have meltdowns” (I). Andy shared a conversation that he had with his mother when they were shopping for clothes. He showed his mother a particular shirt and said, “Please don’t buy me a shirt that feels like this. I will burn it” (I). He said that they soon began to suspect he might be autistic. Many individuals reported missed diagnoses in their early years, misattribution of the diagnosis to other health conditions, and a general lack of understanding from health service providers. Some individuals and their parents reported looking for a diagnosis that would explain the difficulties they faced and lead to support from services without even considering autism.

Although ASC is recognized as a condition that presents between 18 months and three years, most of the participants in this research did not receive a diagnosis until they were already enrolled in school. Four were in elementary school, two were in high school, and two were in college. Only three received an earlier diagnosis. Those with early diagnosis described their experience through the social identity of their condition. Harry said, “I was labeled special needs when I was a child. That stigma still remains. It sort of colored everything for me when I was growing up” (A). David shared a similar experience. “People would just say things about me. Sometimes, people thought if I didn’t act a certain way, (they thought) I must be cured. Some people thought I was lazy” (I). Zero said, “Everyone acted like I might break all the time” (I). Late-diagnosed autistic individuals often encounter mental health challenges exacerbated by a lack of understanding about their experience. Conditions such as anxiety, depression, and identity-related stress may be more prevalent in those who receive a diagnosis later in life, and

these challenges tend to intensify as these individuals transition into adulthood (Lai et al., 2019; Lupindo et al., 2023). A delayed diagnosis may lead to a prolonged period of social challenges and difficulties in forming meaningful relationships. Autistic individuals may experience a sense of isolation due to their distinct communication and social interaction styles. Late recognition of their developmental condition can contribute to feelings of alienation, as they may have struggled for years to understand and navigate social expectations without the benefit of appropriate guidance (Happé et al., 2016; Lupindo et al., 2023). Robot reflected on his elementary and middle school years, saying, “My peers, most of the time, didn't like me. I didn't interact with them in a great way. It was very difficult to make social connections. I didn’t get that I was, you know, doing things differently” (I). He also noted, “By the time I got to middle school, I had learned to mask so well for adults that I kinda delayed my own diagnosis. I knew what they were looking for and just imitated it all the time” (I).

How Life Is Different For Me

Autism can significantly impact the college experience for students in higher education. The transition to college, often the first taste of independent living, can be particularly challenging for students with autism. While many students revel in their newfound freedom, the responsibility of staying organized and on track can be overwhelming for those with autism. Robot suffered a great deal of physical and mental anguish during this transition:

> When I moved away from home, I ended up being very unhealthy, had a terrible sleep schedule, and had like no support. The thing that got me out of that was getting on medication that helped me focus and learn to listen to the people around me who were trying to help me (I).

These and other executive function issues, like difficulties with prioritizing, time management, and organization, are common, and the absence of familiar support services can exacerbate these

challenges. Robot acknowledged that “the support that I actually needed wasn’t for academic reasons. It was always for helping me get out of bed in the morning and getting to class on time” (I).

This can lead to a situation where students may excel academically but struggle emotionally, or they may find the demands so high that they struggle to cope in a competitive college environment. When Galaxy described his experiences with support, his discussion centered around testing situations and the perspectives of his professors on accommodations. He noted, “For one class, I have a separate testing environment, and I am allowed time and a half to complete the exam. The professor is really helpful and supportive” (I). With his other classes, however, he is struggling. “I have two rigid testing schedules that are back-to-back. I’ve talked to the professors, but they aren’t willing to make any accommodations, so I have to work with the constraints” (I). He also observed that “The administrator in the computer science department has always been really good about making sure I have a good room for my exams. That isn’t always true for other students” (I) His comments demonstrate the multifaceted challenge faced by the students and the institution alike. For Galaxy, the primary challenge is dealing with the characteristics of his autism that hinder his academic progress. The professors face the dual challenge of understanding the students’ needs and having the time and resources to meet each unique need. The institution has the responsibility of coordinating access, support, professional development, and student goals to produce the best possible outcome for all stakeholders. An alert professor can make a huge difference for an autistic student. Zero described one such professor saying:

> If I'm not being stimulated by what I'm learning, I often fall asleep. I can’t help it. One of my professors noticed that, and he started bringing puzzles to class for me to solve while

learning. He's like, “You're not gonna fall asleep today. Solve this. And take your notes at the same time.” And it worked for me (I).

If faculty and staff are not alerted to the needs, those needs may go unmet. Many participants spoke of learning to advocate for themselves and others as part of the support process. Aayliah noted, “ When I’m struggling in class, I know that it won’t get better unless I say something” (F). When asked about learning to advocate for herself, she responded, “ I think for me, it’s my parents that helped the most. They taught me to be independent. They taught me that I can’t use autism as an excuse. I have to speak up” (F).

The participants in this study also reported numerous challenges related to the physical and academic environment of the college campus. The physical and sensory environment in the educational setting has a profound impact on the experience of autistic students. Andy observed, “The lighting causes me problems. I'm not able to concentrate; I drift away. Sometimes, it affects my moods, and I feel sad. Some of my online friends told me that’s pretty common. I didn’t know about it” (I). Navigating and utilizing aspects of the campus, as well as engaging and participating at the university, can be influenced by the physical and sensory aspects of the environment. Galaxy said, “I have to wear my headphones in most classes. And the lights drive me crazy! Sometimes, I have to sit in a dark room to get over it” (I). Many autistic students require space and resources to manage sensory overload on campus.

Additionally, the college campus was, for many of the participants, a new opportunity to compare themselves to other young adults experiencing independence for the first time. Andy says that he still compares himself to other students. “At times, I feel like I'm really struggling compared to other students like it seems easy for them. I know it is not a good idea, but I feel like, at times, I’m just not ready to be here” (I). Alexie agreed, saying, “ I feel like everyone else has an easier time here. It’s probably not true, but that’s how it feels” (I).

Autistic students may need unique support and accommodations in higher education. These supports may come from the faculty, administration, or sources outside of the college. The participants noted the value of support in various ways. First, accommodations in the classroom paved the way for success. Andy said, “I have a professor who asks us a lot of questions about how much knowledge we have before she begins teaching to find out what we already know. And the questions help me to know where we’re going” (F). Lucy agreed that the class professor's approach is crucial to success.

> I had a professor who did not understand that I was having a hard time. I thought that he just didn’t care. When he finally understood, he changed completely and took lots of time to help me get through. He had me move up front so I could see better, and he got someone to help me with taking notes. It made a difference (F).

Galaxy also spoke about the professors when he observed that “Before anyone teaches anything, they should find out why the students are there and what they hope to do with the knowledge from the class” (I). He also elaborated on his situation when he began college. “I needed help with problem-solving and with breaking problems down into smaller parts. I just wasn’t ready when they went right into some of the harder things” (I).

Clear communication can be a challenge for students on the spectrum. David noted that he regularly misunderstood conversations with teachers and professors even when he was doing well. “When I was doing work and teachers were, like, giving me support at school, and then they would say to work independently, I felt like they just didn't want to help me. I felt like I was a failure” (I). Harry says that he often misunderstands professors and classmates, “Sometimes when they are trying to help, I just don’t get it, and I start thinking that they are putting me down, but I know they aren’t. It’s really frustrating because I really want to be here” (F).

How I Fit In

The classroom and campus atmospheres have a significant impact on the academic success of autistic students. Autistic students may perceive higher education as more positive when they feel included and accepted. An inclusive environment that recognizes and celebrates neurodiversity—especially the uniqueness of each autistic student—fosters a positive perception of higher education. Near the end of his interview, Andy said of his college experience, "I'm just looking for a place where I don't have to pretend" (I). An inclusive environment that values neurodiversity and accommodates diverse learning styles can contribute to a more positive perception. On the other hand, experiences of exclusion, stigma, or misunderstanding may lead to a less favorable view of the higher education experience.

Autistic students may face challenges in navigating the social landscape of higher education. They may experience difficulties in social interactions, including understanding social cues, making friends, and navigating complex social situations. Harry said, " Some students, the way they treat you, it can make you feel like you don't belong" (I). Kelly described her social experiences, saying, "I'm not sure people realize the sheer amount of effort that it takes for me to just talk to someone. Sometimes, I'll be a whole week without seeing people that I know or even friends" (I) Interactions with peers, faculty, and staff can be complex, and the unwritten social rules may be difficult for them to interpret (Donachie et al., 2017; White, 2018). Andy said, "I don't know how to read facial expressions or body language, and people get upset a lot. Socializing leaves me confused, not knowing what's going on. It can be really exhausting" (I). Lucy shared a similar point of view, "As a teen, I couldn't have a conversation with anyone. I didn't know that most communication is non-verbal. I missed most of what they were saying to me. Everyone was always getting mad at me" (I). Harry agreed, "Being unable to read people has also gotten me in many situations I didn't want to be in"(I). In a higher education setting, which often involves group activities, presentations, and collaborative projects, these social

challenges can be particularly pronounced. Autistic students may perceive the social aspects of higher education as overwhelming or stressful. Capy observed, “People know not to invite me to parties. I just won’t go. It’s too hard. I’m just masking the whole time” (I). Andy described a similar sentiment, “ I’m a very introverted person, so it's not very easy to get me to hang out with people outside of the classroom. Faking it is just so tiring. Most of the people I socialize with are online” (I). Establishing social connections may require additional effort, and many may limit themselves to forming connections with individuals who share similar interests or neurodiverse experiences. While most autistic people withdraw from social settings due to the burden of masking, many report a sense of loneliness. Kelly said, “I'm not that person that likes being alone most of the time. I love the company of friends. I value them because they remind me that they accept me and encourage me” (I). Galaxy agreed, saying, “I hate being alone. I just can’t handle the pressure of being around people, especially people I don’t know” (F). Those on the spectrum often face the choice of masking in social settings or avoiding socializing. Neither seems to be a good option for them. Finding a place that gives them a sense of belonging in higher education seems to be a great challenge for autistic students.

Implications for Policy or Practice

Maintaining sound institutional policies and practices in higher education is a fundamental step towards creating an inclusive and equitable learning environment that meets the needs of autistic students. It not only benefits the autistic students directly but also enriches the overall educational experience for the entire campus community. Autistic students, like any other students, have diverse strengths, challenges, and learning styles. Recognizing and addressing their specific needs contributes to a more accessible educational experience.

Implications for Policy

Institutional policy changes that promote inclusive learning environments are fundamental for enhancing the self-efficacy of autistic students. By embracing inclusive practices, educational institutions can create an academic atmosphere that supports neurodiverse students. By recognizing and accommodating diverse learning styles, these policies contribute to a sense of belonging, allowing autistic students to perceive themselves as integral members of the academic community.

First, institutions should develop clear and comprehensive guidelines for accommodating autistic students. Implementing a standardized system for accommodations can be transformative. This involves creating a transparent process for requesting accommodations, training faculty and staff on neurodiversity, and ensuring that physical and virtual spaces are accessible. These guidelines should include strategies for faculty and staff to create an inclusive learning environment, promote awareness and understanding of autism, and provide resources for students to disclose their autism status and request accommodations. Ensuring that academic institutions have well-defined policies for supporting autistic students can help minimize barriers to their success. A written copy of these guidelines should be made available to every student when they enroll. It should be available in various locations on campus and on the institution's internet presence.

Another significant policy change is the provision of individualized support plans. Offering a variety of support services, such as quiet spaces on campus, sensory-friendly environments, and extended time for exams, could be beneficial. Tailoring these accommodations to the individual needs of the student is crucial in fostering a supportive environment. Universities should establish a system where each autistic student can work with a support services coordinator to create a customized plan that addresses their specific needs and

challenges. This plan might include academic accommodations, social and sensory support, and access to mental health resources. By tailoring support plans to each student's requirements, higher education institutions can assist autistic students in succeeding in their academic pursuits and personal growth.

Finally, the promotion of neurodiversity awareness and acceptance should be an integral part of campus culture and policies. Universities can create workshops, training programs, and events that educate the entire campus community about neurodiversity, including autism. Encouraging empathy and understanding among peers, faculty, and staff can help reduce stigmatization and foster an environment where autistic students feel valued and respected. Awareness and acceptance include recognition that the experiences of neurodiversity can create unique financial burdens for the student, which might hinder their financial success. Policy changes should address the financial burdens often faced by autistic students and their families. This could involve offering scholarships, grants, or other financial aid opportunities specifically for autistic students, as well as creating resources to assist them in navigating the complex financial aspects of higher education. By addressing the financial barriers that can impede access to higher education, we can ensure that autistic students have equal opportunities to pursue their academic goals and reach their full potential.

Implications for Practice

Several significant classroom practice changes can be implemented to improve the higher education experience for autistic students. Effective classroom practices play a pivotal role in creating an inclusive higher education environment for autistic students. These practices should include all aspects of the classroom environment as well as the academic and social communications that students experience in higher education.

The classroom environment is a combination of the physical area and the teaching atmosphere that students encounter. Educators should be trained in recognizing and accommodating sensory sensitivities, creating a classroom environment that minimizes sensory overload and supports better concentration in the classroom. When possible, faculty should be encouraged to adopt UDL principles, ensuring that instructional materials and methods are accessible to all students. This may involve providing diverse means of representation, engagement, and expression and recognizing the varied learning styles and preferences of autistic individuals.

Academic communication describes the methods of presenting instruction and assessing mastery of material"l. Flexibility in communication methods is critical. Autistic students often benefit from unambiguous instructions and expectations, reducing anxiety and promoting a more structured learning environment. Implementing visual aids, such as written instructions, diagrams, or visible schedules, can further enhance understanding and provide a reference point for autistic learners throughout the academic term. This includes offering a syllabus at the beginning of the course that outlines the schedule, assignments, and expectations in detail. This should also include breaking down complex tasks into smaller, manageable steps, providing visual schedules, and offering reminders for deadlines. Creating a predictable routine within the course can contribute to a more comfortable learning environment for autistic students. Additionally, educators should be encouraged to employ technology as an ally in the classroom, incorporating assistive tools and platforms that facilitate communication, organization, and information processing for autistic students. Implementing clear and explicit communication strategies can help autistic students better understand and navigate academic expectations. Additionally, instructors should be open to alternative forms of student expression and assessment, allowing autistic students to demonstrate their understanding. This approach allows

for the customization of learning experiences, ensuring that autistic students can engage with the material in ways that align with their individual preferences and needs.

Social inclusion is another critical aspect to address. Encouraging peer awareness and understanding through awareness campaigns and inclusive events helps to build a more inclusive community within the classroom. Establishing peer mentorship programs can further aid in the integration of autistic students, providing them with guidance and a sense of belonging. Introducing peer support and mentorship programs designed explicitly for autistic students can significantly contribute to their success. Connecting incoming students with mentors who are further along in their academic journey can help in navigating the challenges of higher education. These programs can foster a sense of community, reduce feelings of isolation, and provide guidance on how to manage coursework and college life.

Theoretical and Empirical Implications

Education theory and sound research are essential components of academic success. It is vital to recognize that most learning theories and most prior research regarding autism were developed without the involvement of the autistic community. Bandura's social cognitive theory must be examined for applicability to the neurodiverse community. Researchers must find new ways to involve the autistic community in participatory research.

Theoretical Implications

When Bandura first proposed his learning theory, autism was still diagnosed as a form of schizophrenia (Bandura, 1963; Bandura, 1977; Baker & Lang, 2017; Donavan & Zucker, 2016). This study extends the application of Albert Bandura's Social Cognitive Theory (SCT) to include students on the autism spectrum. SCT provides a valuable framework for understanding and addressing the challenges faced by autistic college students in various aspects of their lives, including academic and social environments. The application of SCT to autistic college students

offers insights into understanding their social interactions, self-perception, and learning experiences. SCT, proposed by Bandura (1986), emphasizes the reciprocal interactions between cognitive processes, behavior, and the environment in shaping an individual's learning and development. When applied to autistic college students, this theory can illuminate the complex interplay between cognitive, social, and environmental factors that influence their educational journey (Kingsbury et al., 2020; Ortiz, 2017).

SCT highlights the role of self-efficacy, which refers to an individual's belief in their ability to accomplish tasks and achieve goals (Bandura, 1997). Self-efficacy beliefs, which refer to an individual's confidence in their ability to perform specific tasks, play a significant role in the academic success of college students. Autistic college students may have lower self-efficacy in specific academic and social areas due to past experiences of difficulties. Bandura's theory implies that robust strategies to boost self-efficacy, such as providing clear instructions, constructive feedback, and individualized support, can be particularly beneficial for autistic students (Bailey et al., 2019; Bandura, 1986). Encouraging self-efficacy can lead to increased motivation and academic achievement.

Additionally, the concept of modeling, a central component of SCT, can shed light on how autistic college students learn social behaviors by observing and imitating others (Bandura, 1986). Autistic college students often struggle with social skills and may benefit from observing and modeling appropriate behaviors. In the higher education context, creating opportunities for autistic students to observe successful role models can be instrumental. A key aspect of Bandura's modeling concept is relational similarity—a social or competency connection between student and teacher (Bandura, 1977; Channaoui et al., 2020; Martin et al., 2017). By providing opportunities for autistic students to observe and practice social interactions in a supportive environment, their social-cognitive development can be enhanced.

Empirical Implications

As noted earlier in this study, neurodiverse individuals face a crisis of identity in virtually every social encounter. There is a great deal of literature that describes the difficulties that autistic people experience in understanding the neurotypical world. There is almost no discussion of the difficulty of the neurotypical world in understanding autism. There is no general agreement on the nature of autism (Brignell et al., 2018; Lai & Baron-Cohen, 2015; Roberts, 2010; Sarrett, 2017). There is little consensus on the best supports and accommodations for autistic individuals. A continual struggle exists between neurodiverse advocates and clinical professionals over defining autism as a difference or a deficit. DSM-5 (American, 2013) lists diagnostic criteria for autism, which are all deficit-oriented. This study directly reflects the evolving understanding of autism, the experiences of autistic students in higher education, and the need for more comprehensive approaches to support those on the spectrum. Additionally, this research illuminates developing paradigms related to ASC, including changing perceptions resulting from the publication of DSM-5 and how online platforms have influenced the voices of autistic communities. There is a significant amount of literature describing the perception of ASC through the prism of clinical and academic professionals. Still, there is a substantial gap in the perception of the experience through the eyes of autistic individuals (Fletcher et al., 2019).

Online support communities play a significant role in the lives of autistic college students, providing them with a unique platform for communication, information exchange, and emotional support. These communities offer valuable support, interaction, and integration while maintaining a degree of anonymity (Fletcher et al., 2019; Lewis, 2023; Zhao et al., 2019). They also serve as a resource for individuals on the autism spectrum to promote both personal growth and academic success. These communities have a significant influence on the academic and personal experiences of autistic students, facilitating a sense of belonging, reducing feelings of

isolation, and enhancing self-advocacy. Online communities have the potential for a multifaceted influence on autistic college students (Mohd Roffeei et al., 2015; Zhao et al., 2019).

First, these communities provide a comfortable space and inclusive environment where autistic college students can connect with others who face similar obstacles and experiences. Online support communities offer a safe and structured environment for them to engage in social interactions (Fletcher et al., 2019; Mohd Roffeei et al., 2015; Zhao et al., 2019). This interaction helps in building essential social skills and reducing the sense of social isolation. The opportunity to share experiences, challenges, and successes fosters a sense of belonging and reduces feelings of isolation. Online communities can also have a profound impact on breaking down societal stereotypes and misconceptions about autism (Lewis, 2023). As autistic college students share their experiences and insights, the broader community can gain a more accurate understanding of the diversity within the autism spectrum. This can foster empathy and acceptance, ultimately contributing to a more inclusive experience.

Secondly, these online spaces are valuable sources of information and advice, offering a wealth of knowledge related to autism, academic accommodations, and strategies for success. These communities serve as hubs for sharing information and resources related to autism and higher education. Autistic students can access valuable advice, study strategies, and guidance from their peers and professionals, which can aid their academic success (Mohd Roffeei et al., 2015; Zhao et al., 2019). Autistic college students can gain insights into disclosure, self-advocacy, and available resources, empowering them to navigate the college environment more effectively. Access to this information enhances their ability to make informed decisions about their education and personal growth.

Autistic students often struggle with self-advocacy, which is crucial in navigating higher education. Online support communities can serve as training grounds for developing these skills,

empowering students to assert their needs and rights (Gillespie-Smith et al., 2021; Lewis, 2023; Zhao et al., 2019). Additionally, online support communities serve as platforms for collective advocacy. Autistic students can join together to address institutional issues related to accessibility, accommodations, and the general campus climate (Gillespie-Smith et al., 2021; Lewis, 2023). This collective voice can lead to positive changes within college institutions, making them more inclusive and responsive to the needs of autistic students.

The perception of higher education by autistic students can vary widely based on individual experiences, strengths, and challenges associated with ASC. Several factors may influence how autistic students perceive the world of higher education (Lowrey et al., 2017; Moseley & Pulvermüller, 2018; Parish-Morris et al., 2019). Some prominent factors are the physical environment, academic expectations, available support, and the campus atmosphere.

The physical environment can be challenging for at least two reasons: sensory sensitivities and novel data input (NDI). Sensory sensitivities refer to the unique and varied experiences of touch, sight, sound, and smell that can overstimulate a person with ASC. NDI describes the autistic experience of hyper-awareness and dynamic memory, which often reduces every new environment to data that is immediately collected and stored in the autistic mind.

Many autistic individuals are hypersensitive to sensory stimuli, meaning they experience sensory input at a heightened level (Howe & Stagg, 2016; Kingsbury et al., 2020; Ortiz, 2020). This can manifest as extreme sensitivity to sounds, lights, textures, and even smells. In a college environment, crowded lecture halls, fluorescent lighting, and noisy cafeterias can become overwhelming for autistic students, leading to sensory overload and heightened anxiety (Jaysane-Darr, 2020; Sarrett, 2017). These sensory challenges can make it difficult to concentrate on coursework, participate in social activities, and even attend classes regularly. The physical

layout of campuses, classrooms, and communal areas may also influence their comfort and ability to navigate the environment (Howe & Stagg, 2016; Ortiz, 2020; Sarrett, 2017).

NDI is an experience almost entirely unique to those on the spectrum. When bombarded with new visual and auditory stimuli, autistic students often struggle with sensory filtering, making it challenging to focus on relevant information while filtering out irrelevant stimuli. This difficulty can hinder their ability to prioritize tasks and engage in class discussions (Kingsbury et al., 2020; Ortiz, 2020). The constant bombardment of sensory information can lead to mental exhaustion and decreased academic performance. Many college campuses lack designated sensory-friendly spaces where autistic students can retreat to regulate sensory input and manage stress. Having these safe and quiet spaces available can significantly benefit the well-being and academic success of autistic students (Kingsbury et al., 2020; Sarrett, 2017).

The academic expectations in higher education do not always account for the unique information-processing approaches of those with ASC. Autistic students often excel in areas such as attention to detail, logical reasoning, and memorization. However, they may face challenges in others, like communication and executive functioning (Donachie et al., 2017; Haas et al., 2016; Happé & Frith, 2006). The expectations of independent learning, time management, and the flexibility required in higher education can be particularly challenging for some autistic students. The academic demands of higher education, including lectures, exams, and group projects, may be perceived differently by autistic students based on their individual strengths and weaknesses (Davidson & Orsini, 2013; Feinstein, 2018; Kingsbury et al., 2020).

The perception of support services can be critical for autistic students. The availability and effectiveness of support services significantly influence how autistic students perceive higher education. Access to accommodations, counseling services, and mentors who understand their unique needs can positively impact their experience (Accardo et al., 2019; Brownlow et al.,

2015; Sarrett, 2017). Conversely, a lack of awareness and support may contribute to feelings of isolation and frustration. Institutions that offer clear and accessible support services positively influence how autistic students view higher education. Conversely, a lack of awareness or availability of such services may contribute to a more challenging perception of the academic environment (Lai & Baron-Cohen, 2015; Roberts, 2010; Sarrett, 2017). Additionally, some autistic students may appreciate the increased independence that comes with higher education. The ability to choose courses, pursue personal interests, and manage one's schedule can be empowering. However, challenges in organization and executive function may also lead to stress if sufficient support and accommodations are not in place (Brignell et al., 2018; Ortiz, 2020).

The campus atmosphere has a significant impact on the academic success of autistic students. Autistic students may perceive higher education as more positive when they feel included and accepted. An inclusive environment that recognizes and celebrates neurodiversity – especially the uniqueness of each autistic student—fosters a positive perception of higher education (Feinstein, 2018; Grandin, 2009; Robison, 2007). Conversely, experiences of stigma or the pressure to conform to neurotypical norms may negatively impact their sense of belonging (Hull et al., 2019; Milton, 2014). An inclusive environment that values neurodiversity and accommodates diverse learning styles can contribute to a more positive perception (Roberts, 2010; Sarrett, 2017). On the other hand, experiences of exclusion, stigma, or misunderstanding may lead to a less favorable view of the higher education experience (Meador, 2018; Kingsbury et al., 2020; Priscott & Allen, 2021).

Autistic students may face challenges in navigating the social landscape of higher education. They may experience difficulties in social interactions, including understanding social cues, making friends, and navigating complex social situations. Many social activities, although relaxing for most students, may actually increase feelings of stress in autistic students (Bailey et

al., 2017; Kingsbury et al., 2020; Sarrett, 2017). Differing styles of communication can be a hindrance in completing classroom assignments, a successful job interview, or participating in research (Haas et al., 2016; Lai & Baron-Cohen, 2015; Tomlinson & Newman, 2017). Interactions with peers, faculty, and staff can be complex, and the unwritten social rules may be difficult for them to interpret (White, 2018). In a higher education setting, which often involves group activities, presentations, and collaborative projects, these social challenges can be particularly pronounced. Autistic students may perceive the social aspects of higher education as overwhelming or stressful. Establishing social connections may require additional effort, and many may limit themselves to forming connections with individuals who share similar interests or neurodiverse experiences (Gobbo & Shmulsky, 2014).

The perceptions of autistic students in higher education are multifaceted and shaped by a combination of sensory experiences, social interactions, academic demands, support services, and the broader cultural context (Burke, 2019; Kingsbury, 2020; Schreffler et al., 2019). Recognizing and addressing these factors can contribute to a more inclusive and supportive higher education environment for autistic students, enabling them to navigate and succeed in their academic pursuits.

Limitations and Delimitations

Limitations are shortcomings that are beyond the control of the researcher (Creswell, 2013). There are many potential limitations associated with this study. As this study is qualitative, the findings are not generalizable to other students with ASC at other institutions. It should also be noted that the sample size of this study was small, which further limits generalizability. Additionally, the findings should not be assumed to have relevancy to all students with ASC in higher education because the experience of autism is unique for each autistic individual.

The participants in this study were ethnically and economically diverse, but it is unlikely that a sample of 11 individuals could adequately represent all aspects of diversity as understood in most higher education settings. The participants are all high-functioning autistic adults with little or no communication challenges. They are all capable of living entirely independently if they choose. This demographic represents a narrow sample of the autistic population. Due to the difficulties associated with locating autistic students who are willing to participate in research of this nature, the decision to use participants who were accessible was essential to complete the study. As a result, this study can only serve as a doorway into this unexplored research field.

Additionally, because this study involves autistic individuals, it is possible that not all participants were able to truly articulate their lived experiences based on the nature of the ASC (Brignell et al., 2018; Ortiz, 2020). Because of this possibility, the researcher had multiple conversations with the participants to develop more robust communication with them, and I conducted the interviews in a safe place and offered various forms of communication (Zoom calls, email, text, etc.) to help the participants feel more comfortable about the process of sharing personal information. Cresswell (2013) noted that individuals may not be prepared to fully communicate at the time of the interview if the researcher does not ask the right questions or connect with the participant in a meaningful way. This was addressed by providing additional time for answers and inviting follow-up emails and conversations.

Another possible limitation of this study is researcher bias. Although I have limited experience with autism or STEM, I recognized the need to exclude my experiences with the phenomenon and let the experiences of the participants speak for themselves. I achieved this by keeping a researcher's reflexive journal (see Appendix H) and employing the process of epoché as described by Moustakas (1994), in which researcher bias is addressed and bracketed out

through the research process. The researcher recognizes, however, that there is very little likelihood of truly eliminating all bias from a research study of this nature.

A delimiting factor in this study was the selection of the participants. In order to ensure that the participants would be capable of contributing valuable data for this study, all of the participants were required to be students in four-year institutions who had completed at least one year of STEM program studies and were recognized as autistic by their institutions. In addition, the participants were all adults who were able to provide consent to participate. No attempt was made to exclude participants with significant communication challenges, but such participants were not actively sought.

Recommendations for Future Research

This research examines the self-efficacy experiences of autistic students in higher education. The transcendental phenomenological study focused on the lived experiences of these students, and my results reflected the essence of their collective responses. The increasing enrollment of autistic students in higher education settings calls for a comprehensive understanding of their unique needs and the development of targeted interventions. To better support autistic students, this researcher recommends further research in two areas: the impact of co-occurring conditions on academic success and the identity experiences of autistic students within the autism community and as a part of the larger academic community.

Co-occurring Conditions

ASC often presents with a variety of co-occurring conditions, ranging from mental health challenges to medical comorbidities. Understanding the impact of these co-occurring conditions is crucial for providing comprehensive and effective support for autistic individuals. Co-occurring mental health conditions such as anxiety, depression, attention-deficit/hyperactivity disorder (ADHD), and obsessive-compulsive disorder (OCD) can pose significant areas of

concern for autistic individuals (Jadav & Bal, 2022; Yarar et al., 2022). Other conditions in autism include sensory sensitivities and medical comorbidities. Gastrointestinal issues, epilepsy, and sleep disorders are common medical comorbidities associated with ASC (Yarar et al., 2022). There is a gap in the available literature that explores how these coexisting conditions impact daily functioning and exacerbate challenges in communication, behavior, and overall quality of life for individuals on the autism spectrum. There is also a gap in available research that foregrounds the voices of those on the spectrum regarding their experiences and needs regarding comorbidities. These co-occurring conditions have profound implications for education and learning outcomes among autistic individuals. There is a great need for additional phenomenological research to describe the experiences of these co-occurring conditions on autistic college students.

Autistic Identity and Support

The evolving nature of diagnostic criteria for autism contributes to the absence of a universally accepted definition for ASC. Over time, the clinical descriptions of autism have changed to reflect a changing understanding of the condition. The shift from DSM-IV to DSM-5 reflects changes not only in the diagnostic criteria of ASC but also in conceptualizations of autism, leading to a more inclusive definition. Further research is needed to describe the experience of autism in a way that can facilitate research and support development. Many autistic individuals find empowerment and a positive sense of identity in the neurodiversity label. While the concept of neurodiversity has gained recognition and acceptance as a means of celebrating neurological differences and challenging the disability stigma of neurodevelopmental conditions, including autism, some autistic individuals may object to the label for various reasons.

One primary concern revolves around the heterogeneity within the autism spectrum. Critics argue that using a single term, such as "neurodiversity," may oversimplify the diverse challenges and experiences faced by individuals with autism. Those who reject the more progressive label highlight the substantial variability in cognitive abilities, communication styles, and sensory sensitivities among autistic individuals, suggesting that a singular label may not capture the nuanced nature of their conditions (Bagatell, 2010). While neurodiversity emphasizes the value of neurological differences, it may inadvertently downplay the profound struggles with communication, social interaction, and daily living skills that some individuals with autism encounter. Critics argue that emphasizing neurodiversity exclusively may neglect the need for targeted interventions and support services that address these specific challenges, potentially hindering access to essential resources for some individuals (Gillespie-Lynch et al., 2015). This concern is especially important since most of the qualitative research involving autism targets participants with milder symptoms in order to facilitate data collection. There is currently very little research that clarifies the dispersion of autism regionally, nationally, or globally. Research is even more limited on the distribution of autism by levels (one, two, and three) as described by DSM-5. Extensive statistical research is needed to identify the autistic population more accurately—both the distribution and the severity—so that more inclusive research protocols can be developed.

Conclusion

Eleven students participated in this study and revealed significant themes about adapting to the academic environment, coping strategies for dealing with the stress of higher education, and their perceptions of fitting in as autistic students in a neurotypical world. Autistic students face many challenges in the educational environment, including sensory stimuli sensitivity and difficulties with classroom presentations. The participants developed coping strategies, including

isolation, pursuing special interests, and gathering support from family and friends. Many of the participants noted the value of online support networks. Attempting to fit into the environment of higher education usually involves some degree of masking by imitating the behavior of others or by concealing behaviors such as stimming. The participants describe the experience of masking as exhausting. Significantly, these students indicated that almost every form of interaction, including the classroom, is a social challenge.

For autistic students, the experience of higher education is unlike that of any other student. In social settings, the experience is masking. In the classroom, the experience is miscommunication. In the college environment, the experience is sensory overload. Autistic students are enrolling in college at a growing rate. In the higher education environment, it is imperative to institute policies that foster inclusivity and support the unique needs of autistic students. The findings of this study underscore the importance of accessible and inclusive learning environments in promoting the self-efficacy of autistic students pursuing STEM degrees. Understanding the impact of internal and external motivating factors is essential for educators and institutions seeking to create more inclusive and supportive environments for autistic students. Autistic students may need accommodations such as extended time for exams, preferential seating, or access to quiet spaces for studying and for recovery from the social experiences of higher education. By providing these accommodations and support systems, educators and institutions can help create a more welcoming environment for autistic students.

There is no single definition of autism that satisfies all of the stakeholders in the experience of neurodiversity. ASC is a neurodevelopmental condition that creates a unique cognitive and sensory profile for each individual on the autism spectrum. It is characterized by a wide range of experiences, including sensory sensitivities, social and communication challenges, repetitive behaviors, special interests, and emotional regulation difficulties. It is essential to

recognize the individuality of autistic experiences, as each person's unique profile contributes to their distinct psychological and experiential journey. Individuals with autism often exhibit atypical patterns of behavior, communication, and social interaction. These differences can vary widely among individuals, which is why ASC is often described as a spectrum. Recognizing this diversity is essential for promoting a holistic understanding of autism and ensuring that interventions, policies, and support systems are sensitive to the complex needs and experiences of individuals on the autism spectrum. Colleges and universities must take appropriate action to ensure that the promotion of neurodiversity awareness and acceptance is an integral part of campus culture and policies. By actively engaging and empowering autistic students to express their thoughts, concerns, and needs, institutions can foster a more inclusive and supportive environment. Administrators and educators must prioritize listening to the voices of autistic students, acknowledging their expertise on their own experiences, and working collaboratively to implement accommodations and support that address their specific challenges and promote their academic success. Giving autistic college students a voice not only validates their identities and perspectives but also enriches the educational community.

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APPENDIX A

LIBERTY UNIVERSITY IRB APPROVAL LETTER

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

November 8, 2022

Tony Banning
Dina Samora

Re: IRB Approval - IRB-FY22-23-294 NEURODIVERSITY PERSISTENCE IN STEM PROGRAMS: A PHENOMENOLOGICAL STUDY OF SELF-EFFICACY AMONG AUTISTIC STUDENTS IN HIGHER EDUCATION

Dear Tony Banning, Dina Samora,

We are pleased to inform you that your study has been approved by the Liberty University Institutional Review Board (IRB). This approval is extended to you for one year from the following date: November 8, 2022. If you need to make changes to the methodology as it pertains to human subjects, you must submit a modification to the IRB. Modifications can be completed through your Cayuse IRB account.

Your study falls under the expedited review category (45 CFR 46.110), which is applicable to specific, minimal-risk studies and minor changes to approved studies for the following reason(s):

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Your stamped consent form(s) and final versions of your study documents can be found under the Attachments tab within the Submission Details section of your study on Cayuse IRB. Your stamped consent form(s) should be copied and used to gain the consent of your research participants. If you plan to provide your consent information electronically, the contents of the attached consent document(s) should be made available without alteration.

Thank you for your cooperation with the IRB, and we wish you well with your research project.

Sincerely,

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
Research Ethics Office

GREENWOOD UNIVERSITY IRB APPROVAL

Xxxxxxxx Xxxxxx

xxxxxxxxxxxxx
xxxxxxxxxxx
Xxxxxxx, XX 12345

xxx-xxx-xxxx Phone
xxx-xxx-xxxx Fax

xxxxxxxx.xxx.edu

June 23, 2023

Liberty University Institutional Review Board
Mr. Tony Banning Dina Samora

Greetings-

I have spoken with Mr. Banning regarding his research study *NEURODIVERSITY PERSISTENCE IN STEM PROGRAMS: A PHENOMENOLOGICAL STUDY OF SELF-EFFICACY AMONG AUTISTIC STUDENTS IN HIGHER EDUCATION.* I give full support to his recruitment of _____ University students in the Xxxx and Xxxxxxxx programs and access to the student organizations, Autistic Students Union and TAPD into STEM.

If you have further questions, please feel free to contact me.

Sincerely,

Xxxxx Xxxxxx Xxxxxx, MSW, LSW
Program Manager
xxxxx.xxxxxxxxxxx.xxx.edu

LETTER HIGHTOWER UNIVERSITY IRB APPROVAL

Date:	December 25, 2022
To:	Tony Banning Dina Samora Liberty University
From:	RCS IRB Office
Name of Institution:	Liberty University
Protocol Title:	Neurodiversity Persistence in Stem Programs: A Phenomenological Study of Self-Efficacy Among Autistic Students in Higher Education
Determination:	Permission to recruit

Thank you for your correspondence regarding the above-referenced study. Based on the information provided, it has been determined that action from this Office is not required, as _____is being proposed as a recruitment site, and not as a collaborating institution in the research.

Please Note:

- Any alteration to the project that could potentially change this determination must be submitted for review prior to implementation.
- This determination does not extend to _____ Health If you wish to recruit participants at_____ Health, contact the _____Health IRB at (XXX) XXX-XXXX.
- Please be aware that it is your responsibility to assess if other institutional requirements may apply to this activity, and to receive associated approval/permission prior to initiating the research.

If you have any questions or comments about this correspondence, please contact the _____ IRB Office at xxxx xxxxxxx@xxxx.edu

Office of the Vice President for Research
Research Compliance Services
xxx Xxxxx Xxxxxxx
XXXXX, XX 12345-6789
PHONE XXX-XXX-XXX FAX
XXX-XXX-XXX

compliance.xxxxx.edu

APPENDIX B

RECRUITMENT LETTER

Dear Student:

As a student in the School of Education at Liberty University, I am conducting research. As part of the requirements for a doctoral degree. The purpose of my research is to describe the experiences of self-efficacy among autistic students enrolled in science, technology, engineering, and math (STEM) related programs. I am writing to invite eligible participants to join my study. Participants must be 18 years of age or older, on the autism spectrum, and have completed at least one year in a STEM-related program of study in higher education.

Participants, if willing, will be asked to participate in a one-on-one interview via Zoom and review the researcher's understanding of the themes of the interview. Additionally, students will be invited to participate in a virtual focus group discussion. It should take approximately three hours for you to complete the procedures listed. Your name and other identifying information will be requested as part of your participation, but the information will remain confidential.

To participate, please click on the link provided for the screening survey. If you meet participation criteria, a consent form will be sent to you via email to complete and return to the researcher. Once the consent form is completed and returned, you will be contacted to schedule an interview.

I truly appreciate your consideration to participate in this study, and I look forward to working with you and learning about your experience. If you have any questions before choosing to participate in the study, feel free to contact me personally at _____.

Sincerely,

Tony Banning,
a doctoral candidate
(xxx) xxx-xxxx/_____

Link to survey: https://forms.gle/Bm2oYd5zDx57my757

APPENDIX C

SCREENING SURVEY

The purpose of this transcendental phenomenological study is to describe the experiences of autistic students currently enrolled in science, technology, engineering, and math (STEM) programs in a four-year institution. This survey is designed to determine your eligibility to participate in the study.

1. Are you 18 or older?

Yes/No

2. Are you recognized by the institution as having received an autism diagnosis?

Yes/No

2. Are you currently enrolled in a STEM major?

Yes/No

3. Have you completed at least one year of enrollment in this institution?

Yes/No

4. Would you like to participate in the research study about your experiences as an autistic student in a STEM program?

Yes/No 5.

Are you willing to participate in an individual interview and a virtual focus group?

And share your experiences in a STEM program in a four-year institution.

Yes/No 6.

Contact phone number:

_____.

APPENDIX D: INFORMED CONSENT FORM
CONSENT FORM

Title of the Project: Neurodiversity Persistence in STEM Programs. A Phenomenological Study of Self-Efficacy Among Autistic Students in Higher Education
Principal Investigator: Tony Banning, Liberty University, School of Education

Invitation to be part of a Research Study

You are invited to be in a research study concerning autistic students enrolled in STEM programs in higher education. To participate, you must be 18 years of age or older, be recognized as autistic by your university, and have completed at least one year in a STEM-related program. Taking part in this research is voluntary.

Please read this form and ask any questions you may have before agreeing to be in the study. Tony Banning, a doctoral candidate in the School of Education at Liberty University, is conducting this study.

What is the study about, and why is it being done?

The purpose of this transcendental phenomenological study is to describe the perceptions of self-efficacy among neurodiverse students currently enrolled in a STEM program at four-year institutions in the United States. The central research question that will guide this study is: What are the self-efficacy experiences of neurodiverse students currently enrolled in a STEM program at four-year institutions in the United States?

What will happen if you take part in this study?

If you agree to be in this study, I will ask you to do the following things:

1. Participate in an online interview with the researcher. The interview will take approximately one hour and will take place at a mutually agreeable time. The interview will be virtual using Zoom. The interview will be audio- and video-recorded and transcribed.
2. Bring a personal item or form of visual representation to the individual interview. The Personal items will represent your experience as a student enrolled in a STEM program at your university. This item may be photographs, journals, a previous assignment, or Other personal items. This artifact is meant to facilitate an anecdotal discussion that should take about 20-30 minutes. This discussion will be audio- and video-recorded.
3. Participate in a focus group via Zoom with other students. The focus group will take approximately one hour. The focus group will be audio and video-recorded.
4. Review and provide feedback on the researcher's findings to ensure the accuracy of the Information. The review and feedback process will involve Zoom conversations, e-mail, or texting as the participant desires.

What risks might you experience from being in this study?

There are risks involved in any research study. However, the risks involved in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

How could you or others benefit from this study?

Participants should not expect to receive a direct benefit from taking part in this study. Benefits to society include informing policies and programs in higher education to assist neurodiverse students in achieving their academic and career goals.

How will you be compensated for being part of the study?

Participants will not be compensated for participating in this study.

How will personal information be protected?

The records of this study will be kept private. In any report that might be
Published information that will make it possible to identify a participant will not be included.
Research records will be stored securely, and only the researcher will have access to the records.

- Participant responses and the university attended will be kept confidential through the use of pseudonyms. Interviews, discussions, and focus groups will be conducted in a location where others will not easily overhear the conversation.
- Data will be stored on a password-protected computer and will be deleted after three years per federal regulation.
- Interviews, discussions, and focus groups will be audio and video recorded and transcribed. Recordings will be stored on a password-protected external USB drive and will be deleted after three years. Only the researcher will have access to these recordings.
- Confidentiality cannot be guaranteed in focus group settings. While discouraged, other members of the focus group may share what was discussed with persons outside of the group.

Is study participation voluntary?

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with Liberty University or the university you attend. If you decide to participate, you are free not to answer any question or withdraw at any time without affecting those relationships. You are always free to withdraw from all or part of the study at any time.

What should you do if you decide to withdraw from the study?

If you choose to withdraw from all or any part of the study, don't hesitate to get in touch with the researcher at the email address included in the next paragraph. Should you choose to withdraw, data collected from you, apart from focus group data, will be destroyed immediately and will not be included in this study. Focus group data will not be destroyed, but your contributions to the focus group will not be included in the study if you choose to withdraw.

Whom do you contact if you have questions or concerns about the study?

The researcher conducting this study is Tony Banning. You may ask any questions you have now. If you have questions later, you are encouraged to contact the researcher at _____. You can also contact the researcher's faculty sponsor, _____, at _____.

Whom do you contact if you have questions about your rights as a research participant?

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515, or email at irb@liberty.edu.

Disclaimer: The Institutional Review Board (IRB) is tasked with ensuring that research on human subjects will be conducted in an ethical manner as defined and required by federal regulations. The topics covered, and viewpoints expressed or alluded to by student and faculty researchers are those of the researchers and do not necessarily reflect the official policies or positions of Liberty University.

Your Consent

By signing this document, you are agreeing to be in this study. Make sure you understand what the study is about before you sign. You will be given a copy of this document for your records. The researcher will keep a copy of the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

☐ The researcher has my permission to audio-record and video-record me as part of my participation in this study.

_____

Printed Subject Name

_____

Signature & Date

APPENDIX E

INTERVIEW GUIDE

An interview guide will be printed before each interview is conducted.

Central Research Question

How do autistic students in STEM-related fields of study perceive the experience of self-efficacy within STEM learning environments?

Sub-Question One

How do autistic students in STEM-related fields of study experience the social campus environment?

Sub-Question Two

How do autistic students in STEM-related fields of study perceive the academic support and accommodations which they receive?

Interview Questions

Introductory Questions

1. Tell me something about yourself

2. What do you like most about being at this school?

3. How did you decide to enroll in a STEM program? CRQ

4. Why did you decide to enroll in *this* STEM program? CRQ

5. Please describe some of the adjustments you have experienced this past year for me. SQ1

6. How confident are you right now that you will complete this program and graduate? CRQ

7. What do you think motivates you most to succeed in college? CRQ

Questions Related to Communication Challenges

8. How do professors differ from one another in their classroom presentations? SQ2

9. What is the most helpful thing you remember a professor doing to help you

succeed academically? SQ2

10. Think of a time you struggled to follow the lesson presented in class. Tell me about that in as much detail as you can. SQ1

11. In light of your experience, what could help you understand class assignments? SQ2

Questions Related to Social Interaction

12. How does your experience in the classroom differ from the experience of other students? SQ2

13. Please describe your comfort level in class and school in general. Use specific examples to describe your feelings. SQ1

14. How does your experience in the classroom affect your confidence that you will succeed in college? CRQ

15. When completing an assignment with a group or cohort, how do you feel about your place in the group? SQ1

Questions Related to Range of Interests

16. Please describe how specific programs or individuals have helped you in this program. Use specific examples. SQ2

17. What hobbies do you pursue in your free time? CRQ

18. Please describe how your interactions with classmates outside of the classroom affect your opinion about your success in college. SQ1

Additional prompting questions will be used to promote fuller description and to gain further information as the interview reveals new directions for data collection. These may include:

1. You mentioned _____. Could you explain why that is important?

2. Could you describe that in more detail?

3. Could you describe a time when that happened to you?

4. Specifically, how did that affect you?

5. etc.

APPENDIX F

ANECDOTE DISCUSSION

Each participant will be invited to bring an artifact—a personal possession, a class assignment, a letter from a family member, etc.—with them to the interview, representing their experience in higher education. The artifacts will be used to elicit anecdotal descriptions from the participants. The researcher will ask the participant to share a story highlighting the artifact's significance. As the participant relates the story, the researcher will employ prompting questions to ask for fuller descriptions of how the experience relates to the experience of self-efficacy. This data collection method should confirm or expand the data obtained through the interview process. Additionally, this data collection method will reveal aspects of an experience that might otherwise remain concealed through traditional interview approaches.

Participant	Artifact	Significance of the Artifact to the Participant
Capy	Class Assignment	He built a program to improve the assignment of testing carrels to improve testing conditions. He sees the world differently and uses that ability to help others.
David	Note From Student	Given to him by another autistic student. The note welcomed him and gave him contact information for support and mentorship. The note let him know that he was not alone.
Aaliyah	Red Rose	Given to herself. She rewards her accomplishments with red roses. They motivate her to keep moving forward.
Lucy	Glass half-full of water	It is something that her grandmother taught her. A half-full glass will help, but you should recognize that it will never be enough. Always work toward the next glass. Do not be satisfied where you are.
Galaxy	Rubik's Cube	A personal favorite. He met Erno Rubik in Budapest. Rubik's accomplishments inspire Galaxy to keep striving for more and overcoming obstacles.
Alexie	Wine Glass	A gift from her uncle after she finished her first semester in college. She keeps it where she can see it to remind her that her family supports and believes in her.
Kelly	Alarm Clock	A gift from her mother when she began college. Her mother told her that she is an adult now with adult responsibilities. Her future is in her hands. The alarm

		motivates her to seize the day.
Harry	Trash Can	Something he got for himself. He was repeatedly told that he was worthless by classmates and peers. When he went to college, he bought the trashcan to remind him that all those words were trash. He knows he is more than that.
Andy	Stuffed Animal	A gift from his former girlfriend. They broke up because she could not deal with his autism, but he still sees the gift as a symbol of support and encouragement.
Robot	Teaching Proposal	He wrote a proposal to promote inclusiveness in STEM programs. He encourages UDL, and this proposal is part of his ambition to become a STEM teacher.
Zero	Broken Gaming System	His first gaming system. It was a gift from his dad. When it broke, he and his dad tried to fix it. His father has always encouraged his inquisitive mind and supported his desire to try new things.

APPENDIX G

REFLEXIVE JOURNAL

DATE	NOTE
7-25-2023	As I pursue this research, I have discovered that I am becoming a strong proponent of Universal Design for Learning. This can become a problem for at least two reasons: First, as part of the epoché process, I am trying to bracket my opinions and remain objective. I am looking for the experiences and perspectives of the participants, not my own. Secondly, UDL is not the focus of my research. To obtain useful data, I have to use the brief interview time wisely. The first student that I interviewed brought up UDL. That's great, but I almost wasted a great deal of time sharing my thoughts. I'm learning what a challenge this can be for a novice researcher.
8-8-2023	I am not happy with the process of connecting with students. I understand the importance of contacting institution IRBs and working with appropriate support services to connect with participants. Still, I am amazed by the reluctance of many staff and leadership officials to support research. This is most true of research that originates outside of their institution, but I had conversations with representatives of two institutions who told me that their schools' support services did not support their own attempts to interview students with special needs. Ironically, when I did connect with the students themselves, they felt that their voices were never heard because they were never given the opportunity to participate in research.
9-22-2023	The participants in my research are all involved in various online autism awareness and support communities. As a result, they know the language of advocacy. They are more informed about varying views of autism than many professionals. They perceive themselves as resources for information rather than individuals in need of support. They also, in many ways, identify more as a class rather than as individuals.
9-30-2023	As I interview students, I am struck by the revelation that most of them are interested in something other than support for better social integration. Many of my participants do not feel alone or left out. They spend their time alone because they prefer it. Their social experiences are primarily with people who have a solid grasp of their autistic experience. They do not look for additional ways to mask or to be more like neurotypical people. They find this exhausting and disingenuous. By contrast, much of the literature that I have studied highlighted the need for more support to help people on the spectrum adapt to typical behavior. It seems that the autistic community is charting a path that differs from the professional approach.
10-3-2023	Covid lockdowns seem to have benefitted the autistic community, especially in their career pursuits. Most of the participants noted that the lockdowns significantly improved opportunities for online employment. This is a preferred alternative for individuals who shun unnecessary social interactions.

12-15-2023	I have noticed that the participants in this study don't really make any distinction between academic environments and social environments. It seems that all situations are experienced through a social lens. The classroom is one more place to navigate non-verbal cues, figures of speech, unwritten codes of interaction, and all of the other qualities that make social interaction so exhausting for autistic students.

APPENDIX H

AUDIT TRAIL

DATE	ACTION
9-1-2023	Defended Research Proposal
9-14-2023	Requested permission from institutions to conduct research
11-8-2023	Received IRB approval for research proposal.
12-25-2023	Received permission for research from the first site
3-28-2023	Modified IRB proposal to include additional research sites
4-1-2023	Began soliciting participants
4-17-2023	Received IRB approval for modification
6-23-2023	I received permission for research from the second site.
7—22-2023	Began collecting data from participants (interviews and anecdotes)
7-24-2023	Began member check following transcription of the first interview
7-27-2023	Began data analysis
8-8-2023	Began additional recruitment through snowball sampling.
9-18-2023	Began writing chapter four
10-12-2023	Began to structure chapter five based on developing themes.
10-20-2023	Continuing with interviews, transcription, and member checking.
11-12-2023	Discovering themes. Hope to confirm with focus group.
11-21-2023	Completed final interview (eleven participants).
11-28-2023	Conducted focus group with six participants. Transcription completed.
12-1-2023	Additional member checking today. Confirmation and agreement on themes.
12-20-2023	Completed writing first draft of chapters four and five.
1-15-2024	Submitted first draft of dissertation for review.
2-16-2024	Submitted second draft of dissertation for review.