Spring 5-7-2020

STUDENTS' PERSPECTIVES ON THEIR LEARNING EXPERIENCES WITHIN AN INCLUSIVE SECONDARY MATHEMATICS SETTING

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by

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A Dissertation

Presented in Partial Fulfillment of Requirements for the

Degree of

Doctor of Education

In the

Bagwell College of Education

Kennesaw State University

Kennesaw, GA

2020

HIGH SCHOOL STUDENTS' PERSPECTIVES ON MATHEMATICS

DEDICATION

Foremost, to God I dedicate my work for His grace made my life, the beauty I see in the world, and the steps I take each day possible. In turn, I bestow hope and light upon my sons, hope and light to push through life's inherent barriers and suffering to fulfill their dreams. May they stumble upon majestic mountains and find within the courage and determination to reach its heights. Furthermore, I dedicate this work to all my students and to all the children to follow us in this world. May they find their own zeniths and uplift our civilization to new peaks not just of knowledge but most importantly, of much needed humanity and benevolence. Finally, to the humankind I dedicate the poem below. May we all find kindness in our hearts to love all children and raise them well, with a free mind.

A Ray of Light
I teach not because of what I know, but because of what I want to learn! I witness
the world being built again and again in the hope that one day, something will click and
a change will occur in the souls of the young – souls that are to uplift us all to new realms!
(Iliescu, 2017)

ACKNOWLEDGEMENTS

I acknowledge the clouds,
the sun, and the moon, and all stars,
for my soul was born and my dreams
beyond a rainbow, up in the sky.

I acknowledge my father
for the gifts passed down upon me,
and I acknowledge my mother
for her teachings in resilience and unwavering will.

I acknowledge the spring of my wondering strike,
the mountains and nature from the place of my birth.
I acknowledge my friends that stood by my side
and my professors I followed in my desire to learn.

I acknowledge my hardships and my pain as well
for they are part of all I do and I am.
I acknowledge my fight to crawl forth
despite how hard I fall every day, face down in mud.

I acknowledge my children and my students who
look up to me with marveling eyes;
and I acknowledge God, for He holds my hand
and opens before me a path full light.

Abstract

Students' perspectives in learning mathematics are important considerations in education yet few studies document their insights. The current investigation used a case-study design and interviews, drawings, clarifying discussions, and focus group interview data collection methods to capture detailed perspectives of high school students with disabilities while learning mathematics. Document data was used to substantiate students' achievement information and the impact of their disability, if any, on their experiences in learning mathematics. The sample of participants consisted of four self-selected high school students, from two inclusive Advanced Algebra classrooms. Three major tenets of Vygotsky's (1978) framework were used to analyze the results of the study, namely the zone of proximal development, the internalization of socio-cultural-historical factors, and the compensatory re-organization of brain functions, all as mediated through socio-cultural-historical processes. Findings suggest secondary students with disabilities 1) are heterogeneous in ability levels, strengths, achievement, interests, and needs; 2) exhibit learning and growth as impacted by socio-cultural-historical supports; 3) are frequently offered limited class selections and reduced standards of excellence; 4) are rarely exposed to varied pedagogical strategies in learning mathematics, including real-world and digital technology applications, and team-work integration; and 5) are often viewed by teachers and school personnel through deficit-based lenses. As positive implications, the participants perceived disability as a difference, part of human diversity, showed constructive transformations over time, were successful as measured by multiple criteria of achievement, and revealed unique insights about the role of the special education teacher and of a team of teachers in their learning and growth.

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Chapter One: Introduction

We live in an increasingly dynamic, complex, and ever-changing society in which technology invades, like an inescapable spider web, all aspects of our life and work. Every day new mathematical language, programs, and algorithms are developed. Every day new digital applications are introduced through computers, electronics, and robotics (UNESCO, 2012). All of them requires educators and students alike to keep up with the fast pace of mathematics and scientific advances.

According to The Organization for Economic Co-operation and Development (2017), an intergovernmental organization founded in 1960 to stimulate economic progress and world trade, a mathematically literate student "recognizes the role that mathematics plays in the world in order to make well-founded judgments and decisions needed by constructive, engaged and reflective citizens" (Organization for Economic Co-operation and Development [OECD], 2017, p. 17). Mathematical literacy is measured as a mean score through the Programme for International Students Assessment (PISA). It tests the ability of 15-year-old students from 60 countries in the world, including the U.S., on three main areas of competence: 1) formulate, interpret, and use mathematics in a variety of situations and real-life applications; 2) describe, explain, and predict phenomena; and 3) recognize the role that mathematics plays in modern society. What mathematics competence means and stands for, therefore, is internationally defined. It takes in consideration the type and level of mathematical knowledge the younger generation needs to possess in order to promote personal and social welfare and worldwide progress. In terms of mathematics competency, results from PISA place the U.S. in the middle range among all countries.

Mathematics, however, is a subject that seems harder to master. The language of mathematics is heavily dependent upon literacy itself – "never wholly free of connotations we bring to words" (Tobias, 1993, p. 54). The building blocks of the mathematical lexicon require time and effort to decode, understand, assimilate, and use with ease at a proficient level, as with any foreign language. In other words, an understanding of mathematics concepts and procedures requires proficiency in mathematics terminology.

Furthermore, mathematics is viewed in the U.S. as inherently difficult. Aptitude is considered more important in developing mathematics competence than effort and being good in mathematics is not regarded as important but rather as optional (Ashcraft, 2002). In addition, the practicality or utility of mathematics (Palacios, Arias, & Arias, 2014), meaning its connection to real-life applications, is not explicit, leaving students wondering why they should learn mathematics in the first place. In spite of a push in our society for STEM competence and the emergence of numerous STEM occupations with a much higher pay and work security than many other professions, mathematics education in U.S. did not increase in its prestige.

The study of mathematics, therefore, comes with a series of difficulties for any student. The achievement of high school students with disabilities, however, is often limited by added factors, including disability specific problems, prior low achievement, low expectations for success, inadequate instruction, inadequate supports, and lack of access to higher level mathematics (Lambert 2013, 2015, 2017; Tan & Kastbert, 2017).

Statement of the Problem

Students with disabilities receiving special education services often come with expected and unexpected learning challenges. Despite this, up to 90% of them are able to graduate from high school fully prepared for a career or post-secondary education if they receive appropriate

socio-cultural-historical supports along the way (Butrymowicz & Madar, 2018). Students with disabilities (as well as of different cultural, racial, ethnic, linguistic, and low-economic backgrounds), however, continue to show an achievement gap in standardized testing, are more often targets of disciplinary actions and more likely to be bullied, and drop out of high school at a significantly higher rate than their non-disabled, white middle class counterparts (Skiba et al, 2008; Gregory, Skiba, & Noguera, 2010).

As a result, individuals with disabilities (as well as other historically disadvantaged individuals) tend to experience higher rates of unemployment, poverty, incarceration, and depression. Furthermore, large-scale longitudinal studies revealed that poor reading skills caused reduced employment opportunities and wages once employed. Poor mathematics skills, however, "resulted in even more dire prospects, even for individuals with good reading skills" (Rivera-Batiz, 1992, Parsons & Bynner, 1997, cited in Geary, 2011; p. 2).

Currently, mathematical skill stands as a "key determinant" of personal and social progress (Vigor, 2013). Indeed, science, mathematics, technology, and engineering (STEM) professionals drive a nation's innovation and competitiveness, sustain the progress and stability of its economy, and raise its overall standard of living. The growth of occupations between 2000 and 2010 in the U.S. alone, for example, was 7.9% for STEM employment, while only 2.6% for non-STEM, with the expected growth for the period of 2008-2018 of 17.0% for STEM occupations and 9.8% for non-STEM (Langdon et al., 2011). In general, the growth in STEM jobs is three times as fast as the one in non-STEM jobs. Additionally, STEM professionals are less likely to experience unemployment and are allocated 26% higher earnings than their non-STEM counterparts are (p. 5). The quality of mathematics instruction, therefore, as a fundamental literacy-laden skill, affects students' future employment and socio-economic status

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and mobility. Nonetheless, it is wildly acknowledged (Lambert, 2013, 2015, 2017; Tan & Kastbert, 2017) that children with disabilities are not offered access to higher level mathematics classes, which in turn limits their career options, in particular as related to STEM occupations.

Given the importance of mathematics in today's modern context, therefore, it seems important to better understand how students with disabilities experience the learning of mathematics at the secondary level and the factors that increase or compromise the likelihood of academic success. Although research documents a plethora of interventions and practical strategies recommended by both scholars and practitioners to support children that show learning and achievement difficulties (Gersten, et al., 2005; Rief, & Heimburge, 2006), there is a gap in literature documenting the opinions and views of students themselves into what they think helps to facilitate their mathematics learning and what does not.

Relevant Historical Overview of Mathematics Education and Special Education

The history of special education in the U.S. is interwoven with the history of mathematics education. Philosophical, psychological, and research streams of thought about human development, learning, and teaching, pushed its progress in a sinuous way to what it is today. Like the riverbed and the current of the water, the socio-cultural milieu in which the education system was entrenched, accelerated or detoured its course.

An exact beginning point of education is hard to determine. Nevertheless, the Soviet's launch of Sputnik in 1957 caused a zealous "gold rush" in producing teachers, scholars, and mathematicians "that would help the United States to compete internationally" (Woodward, 2004, p. 4). Federal funding poured into university-based projects designed to prepare students for computational and conceptual understanding of mathematics and the ability to apply this knowledge to the profitable fields of technical and scientific work.

During the early 1960s, education focused on abstract mathematics concepts at the elementary level – a new movement opposing the existent behaviorist emphasis on rote memorization and drill practice (Woodward, 2004). Teaching and learning methods emphasized making observations and discovering patterns such as "ordering numbers by matching (mapping) a collection of things, building a system of numeration by grouping objects by tens, building the operational tables before memorizing them, and using expanded numeration to develop a meaningful learned algorithm" (UNESCO, 1973, p. 4). Gestalt psychology, Piaget's theory on evolution of the stages of cognitive learning, and Bruner's work on educational psychology, further emphasized "carefully guided", "informed guessing", and "conjecture" as a means to learn through discovery (Woodward, 2004, p. 7).

The conceptualization of learning disability in mathematics occurred somewhat delayed in relation to the onset of the field of mathematics. Students with disabilities and those receiving specially designed instruction were understood as slow learners, incapable of discovery inquiries. In response to this deficit view of students with disabilities, researchers proposed a "diagnostic-prescriptive" approach to facilitate student learning (Glennon & Wilson, 1972). This approach stressed general "remediation techniques", not necessarily mathematics related, ranging from "visual-motor perceptual training to task analysis" (Woodward, 2004). Bloom's taxonomy became a way of "identifying appropriate teaching methods" and "carefully target instructional objectives" to be measured over time (p. 7).

Mathematics reform plunged in 1970's causing a return "back to basics" movement with a focus on reading, writing, and arithmetic in an explicit, step-by-step manner (Woodward, 2004). In 1972, The National Institute of Education sponsored what Woodward (2004) called "the most influential studies of mathematics education at the time" (p. 9) namely, The Missouri

Mathematics Effectiveness Project (Good et al., 1983). Through their study, Good et al. (1983) underlined the link between teachers' effectiveness and students' learning as measured through standardized testing. This movement was a watershed era as federal education policy and funded research projects unmasked the significant disparities among different groups of students (i.e., the poor, mostly of African American background in comparison to their white, middle class counterpart) initiating a dialog about "educational equity". This undertaking stood as the foundation for the Education of All Handicapped Children Act of 1975.

During the 1970s and 1980s, cognitive psychology entered the arena of research and education. Computer simulations started to be used in experiments as a tool to model human processing of mathematical understanding. At the forefront of research inquiries were situated issues that underscored the "organization of information in long term memory, the role of visual images in enhancing understanding, and the importance of metacognition in the problem-solving process" (p. 13). Cognitive research pushed the view on mathematics away from "the basics" toward meaningful and conceptual understanding. The movement culminated with "A Nation at Risk" (US Department of Education, 1983) – a document that stressed excellence in education. Unfortunately, the evolution of research theory and education improvements for students with disabilities lagged far behind. Behaviorism concepts persisted, and the researchers themselves were more interested in instructional strategies and designing interventions than analyzing topics in mathematics. A lot of research in special education focused on mental vulnerabilities and the difficulties in learning mathematics facts, revealing a belief that deficits are attributed to the child and not the system (i.e., educational policy, classroom management, or mathematics pedagogy).

By the end of 1980's, mathematics research moved toward constructivist theory. Its major tenet states that new knowledge is constructed by the learner himself/herself (Glasersfeld, 1989).

The National Council of Teachers of Mathematics (NCTM) pushed forward the Principles and Standards for School Mathematics "in an ambitious call for more rigorous mathematics" as well as a "challenge to develop mathematical power in all students" (Woodard, 2004, p. 23).

Fast-forward to the 1990's, the Secretary's Commission on Achieving Necessary Skills Report (SCANS, US Department of Labor, 1991) as well as research data from the Trends in International and Mathematics and Science Study (TIMISS; data for middle school students across 41 countries) made people feel unease about the transition from a post-industrial to an information economy. In particular, the SCANS report underlined,

> The nation's schools must be transformed into high-performance organizations in their own right. Despite a decade of reform efforts, we can demonstrate little improvement in student achievement. We are failing to develop the full academic abilities of most students and utterly failing the majority of poor, disadvantaged, and minority youngsters. By transforming the nation's schools into high performance organizations, we mean schools relentlessly committed to producing skilled graduates as the norm, not the exception. That, in fact, is the goal of President Bush's education strategy. (p. ii)

A far-reaching change in mathematics research and education was introduced through the implementation of the Elementary and Secondary Act of 2001 (No Child Left Behind Act or NCLB) with its broader politics of accountability and the concept of "scientifically based research" practices to guide classroom instruction. The NCLB extended its course of action to include special education practices as well. A focus on statistics brought to light the increase of students with learning disabilities (Woodward, 2004) and also the issue of overrepresentation of minorities with high incidence disabilities (i.e., learning disability, emotional-behavioral disturbance, and intellectual retardation; Artiles, et al., 2010).

Currently, mathematics research and teaching practice continues to build upon constructivist tenets (Glasersfeld, 1989). Socio-cultural perspectives adopted over the past decade, placing emphasis on group dynamics and the importance of language in learning, continue to uphold relevance in research investigations. Two other closely related lines of thought embodied in critical theory and socio-political perspectives (Gutierez, 2013) inform research and education about the impact on learning and teaching of identity and power issues, as spread through social discourses. Little research, however, applies those lines of thought to disability studies, thereby limiting our understanding of disability and individuals with disabilities to medical, behavioral, and information processing perspectives (Lambert & Tan, 2016, 2017).

Purpose of the Study

Children do not grow in a vacuum. A variety of factors impact their development from the culture and the policies implemented, to home and school structures, to poverty and disability related issues. All elements in the U.S. society have traditionally functioned to aid the success of white, middle class, non-disabled dominant group, while often limited the learning and growth of historically disadvantaged groups consisting of individuals with disabilities and those of different cultural, racial, ethnic, linguistic, and socio-economic backgrounds (Dixon & Rousseau, 2005; Ford & Russo, 2016; Gregory et al., 2010; Landson-Billing, 1999, 2010; Rivikin, 2016; Tan & Kastberd, 2017; Trent, 2010).

The dominant culture of a society influences the education system through 1) its ideology (i.e., business model of education in a competitive society; Tucker, 2011); 2) the choice in policies (i.e., accountability of the teacher in the No Child Left Behind act); 3) its implementation at each subordinate level (i.e., stringent compliance measures and the curriculum

adoption; McLaughlin et al., 2006); 4) school practices (e.g., disproportionate representation of an ethnic, linguistic, or gender group in a specific disability category; Artiles et al., 2010; Ford & Russo, 2016); 5) the value placed on behaviors (i.e., appropriate school conduct; Gregory, Skiba, & Noguera, 2010; Sullivan, 2011) and outcomes of behaviors (i.e., how achievement is measured; Hanushek, 2010); and 6) stereotyping the intellectual ability and the identity of different groups of people (Steele, 1997).

In spite of countless social, cultural, and historical factors that stand against different groups of people, some individuals manage to bounce back from marginalization within a context of deficit-thinking and inequitable learning opportunities. They are able to push through those disadvantages and succeed academically, socially, emotionally, and professionally. They do not let failure incapacitate them, but rather they learn from their mistakes and adapt. What makes some individuals thrive in spite of deficit-thinking prejudices and inequitable opportunities while others fail even with "the wind" in their favor? Are there any particular characteristics or supports, internal and external, that help them overcome drawbacks? What is their particular process of searching for successful supports and strategies and where do they find them?

Given the stated considerations, the purpose of the current study was to gain an understanding of the ways in which students with disabilities experience the process of learning secondary mathematics and the ways in which they successfully negotiate, and even thrive, from reported challenges. A qualitative, case study methodology seemed appropriate to capture the depth of inquiry necessary to unravel the views and opinions of students with disabilities pertaining to their mathematics learning experiences. A case study would also yield an understanding we and the participants themselves gleam from their perceptions.

Research Questions

The purpose of the study was to reveal the learning experiences of secondary students with disabilities from within two inclusive Advanced Algebra mathematics settings. The overarching research question is:

How do students with disabilities experience the process of learning complex mathematics in an inclusion class at the secondary level?

The main question was supported by the following subquestions:

1) How do students with disabilities successfully navigate the challenges they face in learning mathematics at the secondary level?

2) How do students with disabilities perceive their own learning differences within a mathematics class at the secondary level?

3) How do students with disabilities envision an educational environment they would call academically supportive at the secondary level?

Significance of the Study

To hold an edge in leading innovation and production globally, a highly educated and technically competent labor force is needed. Mathematics knowledge and skills are a must for a country's future economy as well as for individual upward mobility, income growth for families, and access for opportunities and high-paying jobs (Langdon et al., 2011; Zuckerman, 2011). The quality of mathematics education, therefore, affects the progress and financial stability of a society and as such it stands as a significant subject of inquiry.

The essential question we need to ask ourselves as parents and educators is: what supports do our children need in order to develop the mathematics knowledge and skills easily transferable to the highly technologized professions of today's economy? Also, what are the

conditions in which children learn best and what kind of learning environment should we, as a society, promote in order to ensure the learning of meaningful and adaptable mathematics competencies for all children? What students need in order to be successful in learning, therefore, is an important consideration in improving mathematics education and further, in ensuring a technological competent work force.

In accounting for success in education, "we tend to look to individuals, their psychologies and pedagogies, rather than to phenomena characterized as social, cultural, institutional, or historic" (Simola, 2005, p. 455). Considering mathematics learning as socio-cultural-historical determined instead implies we, as a society and educational system, allow space to address external factors that impact students' growth. Addressing those factors could provide each child a better chance to perform well in school and achieve a better standard of living for himself/herself ultimately, and by extension, for our nation.

The most reliable means to attain information about what facilitates or impedes learning of mathematics is to ask the students themselves, as they are consumers of education. As Groves and Welsh (2010) expressed, "students' insights are important as a basis for their active and productive involvement, and where there is a serious intention to improve students' learning" (p. 90). Since our society is in constant development, the factors that influence students' learning are evolving as well, therefore, a constant inquiry into their insights is a must if education is to keep up with students' likes and dislikes, wants, interests, and needs.

Little research, however, directly addresses children's views and opinions and even less so the perspectives of secondary students with disabilities in qualitative studies (Lambert & Tan, 2016, 2017). As such, their perspectives on what impacts their learning of mathematics and their progress in school remains uncharted, and less likely to be addressed in educational practice.

Given that 14% of the total school population within the U.S. has a disability, and that 90% of them could, with appropriate supports perform on or near-level with their typically developing peers (Butrymowicz & Madar, 2018), an inquiry into their experiences in learning mathematics might reveal factors that aid or impede their success. Such insights are beneficial in improving mathematics education and the opportunities in life for all children alike.

Finally, awareness of the perceptions of secondary students with disabilities can help us gain understanding of the richness embodied in human diversity, adaptability, and resilience. I contend that students are typically the experts in what works and doesn't work for them and, therefore, inquiring into their perspectives would help educators, researchers, and politicians support, design, and implement more effective and more inclusive teaching practices that support diverse methods of demonstrating learner proficiency. As Gutierez (2013) argues, "it is from the views of subordinated individuals and communities that we will learn how to rethink mathematics education" (p. 39).

Definition of Terms

The terms used in the corpus of the research are explained in the following working definitions.

Attention Deficit Hyperactivity Disorder (ADHD)

Attention Deficit Hyperactivity Disorder (ADHD) is consider a neurobehavioral disorder affecting 3 to 12 % of the population (American Psychiatric Association, 2000). ADHD interferes with an individual's capacity to regulate activity level (hyperactivity), inhibit behavior (impulsivity), and attend to task (inattention) in developmentally appropriate ways. ADHD is not an educational but a medical diagnosis, endorsed by a doctor. Many individuals with ADHD are prescribed medication in order to control their behavior (Rief & Himburge, 2006).

Autism Spectrum Disorder (ASD)

Autism spectrum disorder (ASD) is defined as "behaviorally defined neurodevelopmental disorder associated with the presence of social-communication deficits and restricted and repetitive behaviors" (Ousley & Cermak, 2014, p. 20). ASD represents a heterogeneous group of students with core symptoms falling along a continuum or spectrum, manifesting different cognitive, language, emotional, and behavioral abilities and difficulties. Autism manifests from an early age and is medically diagnosed. The current study looked at students with high-functioning autism (HFA) included in general education classes. Students with HFA are considered having a full-scale IQ of 80 and above (Mayes et al., 2009). In the corpus of the study ASD would be used. Since the study looks at the perspectives of students with disabilities from inclusion classes, however, it comprises ASD students from the average to high end of the spectrum.

Disability

President Bush signed the American with Disabilities Act (ADA) into Law in 1990. ADA expands the protections for students with disabilities in school districts as underlined in the Section 4 of the Rehabilitation Act of 1973 (Yell, 2012). Following the definition from Section 4, ADA delineates persons with disabilities as having "a physical or mental impairment that substantially limits one or more of the major life activities of such individual" (ADA, 42 USC § 1210 [2]).

High-Incidence Disability

Students with high-incidence disabilities are the most prevalent among children and youth with disabilities in U.S. schools (Gage et al., 2012). This group includes students with emotional disorders (ED), specific learning disabilities (short LD), and mild intellectual

disability (MID; Artiles et al., 2010, p. 281). Recently however, students with other disabilities such as High-Functioning Autism (HFA), Attention Deficit Hyperactivity Disorder (ADHD), and Speech and Language Impairment (SLI) are being identified at higher rates and can be included in "an aggregate 'other' category within high-incidence disabilities" (Gage et al., 2012). The current study considers high-incidence disabilities the following categories: 1) Specific Learning Disability; 2) Attention Deficit Hyperactivity Disorder; and 3) Autism Spectrum Disorder (i.e., high functioning autism) due to their higher prevalence in inclusion classes in the setting under investigation.

Historically Disadvantaged Groups of Students

In a school culture that focuses on student achievement as measured through standardized curriculum and testing, disadvantaged groups are traditionally less successful. The category of "historical disadvantaged groups of students" (also referred to in literature as disenfranchised, traditionally marginalized, or students with high-risk backgrounds) includes students with disabilities, from different races and ethnicities (or students of color), from low socio-economic status, immigrants, and students with limited English proficiency. Those students have historically less access to high level mathematics (Lambert, 2013, p. 404). Because their success in school is limited, their confidence and self-esteem can be damaged (Larson, 2010) and therefore adds to their challenges of achieving at the same level as their white, non-disabled, and middle-class counterpart. The current study focused on students with disabilities as historically disadvantaged. Other characteristics, however, such as race and ethnicity, socio-economic status, immigration status, and limited English proficiency might overlap and add to the difficulties experienced by students with disabilities.

Inclusion

The term refers to the inclusion of students with disabilities in a general education classroom, considered their least restrictive setting. Students with disabilities (i.e., LD, ADHD, ASD), therefore, are included in classes with students without disabilities at each grade level. The classes have two teachers, a general education content specialist and a special education teacher, both involved in teaching and supporting the learning of students (Lambert, 2017).

Individual with Disabilities Education Act (IDEA)

President Ford signed in 1975 the Education for All Handicapped Children Act (EAHCA) in order to meet the needs of students with disabilities. The EAHCA amendment from 1990 changed its name to the Individual with Disabilities Education Act (IDEA), which was further amended in 1997 and 2004 (Yell, 2012, p. 63). The purpose of the IDEA is: 1) to ensure free and appropriate public education for all students according to their needs (FAPE); 2) to ensure the protection of rights for parents and students with disabilities; and 3) to assist states and agencies to provide education to all students with disabilities (IDEA, 2004). The 13 disability categories delineated in IDEA are: autism, deaf-blindness, deafness, hearing impairment, intellectual disability, multiple disabilities, orthopedic impairments, other health impairment, emotional disturbance, specific learning disability, speech and language impairment, traumatic brain injury, and visual impairment, including blindness (Yell, 2012, p. 67).

Individual Education Program (IEP)

IEP is a legal document in U.S. schools that establishes eligibility for special education services (Lambert, 2017). The IEP contains information pertinent to a student's special education program; its purpose is to ensure a "meaningful educational benefit" to the student. It contains current functioning information, eligibility category, classroom educational placement,

accommodations/modifications needed in class and during tests, goals and objectives according to student's reported weaknesses, and the evaluation and measurement criteria of his/her progress (Yell, 2012, p. 235).

Intelligence Quotient (IQ)

The intelligence quotient is the quantification of an individual's intelligence or potential as measured by a standardized test relative to peers of a similar age, which tends to remain stable across lifespan (Matzel & Sauce, 2017). Scientists developed different psychometric tests to measure intelligence (i.e., Sanford-Binet, Weschler Intelligence Scale for children or for adults, Woodcock–Johnson Tests of Cognitive Abilities, Differential Abilities Scale, or Raven's Progressive Matrixes) including different domains of abilities such as, verbal comprehension, working memory, perceptual reasoning, and processing speed. Typically, normed referenced intelligence tests are designed so that the mean or average score is of 100 points with a standard deviation of 15. Approximately two-thirds of the population score in the middle range, between 85 and 115. About 2.5% have scores above 130 and about the same percentage, below 70 (Ortiz & Lella, 2004).

Learning Disability (LD)

The highest percentage of students identified as presenting difficulties in learning are children and teens with learning disabilities (LD) affecting between 5 to 15% of the population (US Department of Education, 2001). From a medical standpoint, LD is conceptualized as a neurological deficit, unchanging and common to an individual, which causes an unexpected failure to learn. Deficits can affect students in any combination and degree, including their ability to receive or input information into the brain, process that information, store and retrieval from memory, or respond to or produce information through oral or written language (Rief &

Himburge, 2006). Individuals with LD are taught mostly in a general education setting with supportive services and have at least average intellectual ability (IQ). The LD eligibility criteria is assumed when a student presents an observed discrepancy between his/her ability (IQ) and his/her performance in a particular school domain (Lambert, 2017, p. 530).

Mathematics with Support

Mathematics with support is a remedial type of mathematics class. It is typically the lowest level mathematics among four options (i.e., Advanced Placement, honors, on-level, and mathematics with support) offered to students without disabilities.

Response to Intervention

Response to Intervention (RTI) is a multi-tier approach to the early screening and support of students with learning and behavior needs (Flecher & Vaughn, 2009). The RTI process addresses striving learners in the general education classroom. Upon identification, students are provided with interventions at increasing levels of intensity (increasing level of interventions through Tier 1, 2, and 3). Progress regarding their rate of learning and level of performance is monitored and educational decisions are made based on each student response to the implemented interventions. RTI is used for both general education and special education decisions. The primary goal of RTI is improved academic and behavior goals for all students. The secondary goal is to provide data for identification of learning disabilities.

Vulnerabilities

Disability literature includes a series of medical terms that hold a pejorative weight in our culture such as deficits, impairments, or weaknesses (Lambert, 2015, 2017; Lambert & Tan, 2017; Tan & Lambert, 2019). The current study considers the synonym "vulnerabilities" as a socio-cultural acceptable replacement of the negative connotation encompassed in the terms used

to describe disability difficulties (see the following studies that use medical terms to describe students' difficulties: DuPaul & Volpe, 2008; Geary, 2004, 2011; Fchus & Fchus, 2002; Kim et at;, 2006; Koffler et al., 2009; Mattron et al., 2013; Mayes et al., 2009). The antonym, or its positive counterpart is "assets." Throughout the document, therefore, vulnerabilities and assets were operationalized in place of weaknesses and strengths. The medical lexes will be used occasionally in the context of the reviewed studies and as expressed in the studies themselves. Additionally, they will be used in the context of students' IEP because the terms deficits, weaknesses, and strengths appear as such in the corpus of the document.

Vygotsky's Socio-Cultural-Historical Framework (1978)

Vygotsky's theory is known in research as socio-cultural (Wertsch, 1994). Yet, Vygotsky used the expression socio-historical (Vygotsky, 1934) to describe the development of inner speech and verbal thinking. He argues, "we can anticipate that the basic features of the historical development of behavior in this domain will be directly dependent on the general laws that govern the historical development of human society" (p. 114). The term "historical," therefore, designates two aspects of transformation. On one hand it refers to socio-cultural changes during the lifespan of an individual with its impact on his/her development. On the other hand, it considers socio-cultural changes as they occurred during the history of the humankind. The current study adopted Vygotsky's socio-cultural-historical theory (1978) in order to account for the impact of socio-historical phenomena on human development as a transformative process mediated by cultural tools.

Overview of the Chapters

The current study is organized in six main chapters. The first chapter starts with a short introduction followed by the statement of the problem, and an overview of mathematics and

special education history as a background for the study. Next, the purpose of the study is presented, followed by the research questions, the significance, and definitions of the significant terms used throughout the study. Chapter one provides the rationale for conducting the study.

Chapter two will comprise a review of relevant literature that focuses on mathematics learning of secondary students with different disabilities (i.e., Learning Disability, Autism Spectrum Disorder, and Attention Deficit Hyperactive Disorder) and a description of the theoretical framework through which the results of the study will be analyzed and interpreted. The chapter will conclude with a short presentation of the methodological research design and a rationale for its selection. Chapter two serves as a theoretical foundation for the current study.

Chapter three will consist of an overall presentation of the methodology chosen for the study to answer the overarching research question: How do students with disabilities experience the process of learning complex mathematics in an inclusion class at the secondary level? It will include information about access to the research site, the context of the study, participant selection and a portrayal of each participant, data sources, data collection procedures, and data analysis procedures. The portrayal of each participant will consist of information gathered through biographical interviews and document reviews. The methodology chapter will close with ethical considerations in conducting qualitative research with human subjects, a description of the measures that will be taken to ensure the validity and trustworthiness of the study, and a disclosure of researcher's positionality in relation to the subject of inquiry.

The results of the study will be presented in chapter four, which will be organized in three subsections. The first subsection will include the responses to the research question and subquestions gathered through biographical, open-ended, informal conversational, and focus group interviews. The answers will be presented independently and grouped by respondent,

specifically Armando, Benjamin, Caleb, and Daniel. The second subsection will include students' self-generated drawings to two prompts (see Appendix B and C) and their interpretation of their visual representations given in informal conversational interviews. The third subsection will cover cross-case analysis of common patterns discovered in the data, grouped in several relevant themes and subthemes. Researcher generated memos were developed throughout the entire research process. They were used to note, create, and refine the codes and the themes and find meaning within the raw data.

Lastly, chapter five will provide a summary of the study; a discussion of the findings within Vygotsky's socio-cultural-historical framework (1978); limitations and delimitations of the study; implications for practice, policy, research recommendations for future research; and the conclusion.

Chapter Two: Review of the Literature

Chapter two begins with an introduction which delineates the various sections of the literature review and a brief description of the methods used to select relevant studies and seminal works for the topic of interest of the current study. The subchapters of the literature review were organized on several themes (Litchman, 2010, p. 130): 1) students' characteristics in studying mathematics; 2) socio-cultural-historical construction of ability and disability; 3) supports in learning mathematics; 4) perceptions of students with disabilities in learning mathematics; and 5) perceptions of mathematics learning of students with disabilities. Next, the theoretical framework, methodological design, and the summary of the chapter are presented. The literature review comprises information relevant to answering the overarching research question: How do students with disabilities experience the process of learning complex mathematics in an inclusion class at the secondary level?

The first subchapter starts with a presentation of the characteristics that help all students be successful in learning. Disability differences add challenges to those general features. The subchapter is further divided in two sections; one includes the vulnerabilities of students with disabilities presented in research and the second one reveals the assets used to compensate for disability difficulties. The vulnerabilities and assets are presented for three disability categories that appear most frequently in the inclusion classes I teach (i.e., LD, ASD, and ADHD). A discussion about possible socio-cultural-historical construction of ability and disability follows in the second subchapter. The third subchapter presents studies that highlight the supports that help students in general, and students with disabilities in particular achieve success. The fourth subchapter examines critical reviews and meta-analytic studies, as well as quantitative, mixed methods, and qualitative empirical investigations that disclose how students with disabilities are

conceptualized and studied in research. The fifth subchapter explores what the students themselves expressed about learning mathematics. It includes two subcategories, one focuses on students' opinions in general, another on the views of students with disabilities specifically.

The subsequent part includes a presentation of Vygotsky's socio-cultural-historical theory (1978) as the theoretical framework of the study and an explanation for choosing this perspective to analyze and interpret the data. It is followed by a presentation of the chosen methodology design and a justification of its appropriateness to answering the research questions. The chapter concludes with a summary of the literature review and a rationale for addressing a gap in the theoretical framework, one in the age group, and one in the methodology used in past studies to analyze the perspectives and experiences in learning mathematics of high school students with disabilities.

Search Process

To find relevant articles for the literature review, I employed a systematic search as recommended in several articles and books (Boote & Bailey, 2005; Lambert & Tan, 2016, 2017; Marita & Hord, 2017; Roberts, 2010). The articles were located using a series of online databases including *ProQuest, Google Scholar, Education Resources Information Center* (*ERIC*), *Research Gate,* and *Education Sciences*. Following the results of a content analysis conducted by Lambert and Tan (2016, 2017) on the divide between mathematics and special education research, I structured the keyword search (and combination of words) on four categories: 1) mathematics education articles that include students with disabilities; 2) disability/special education articles that focus on learning mathematics; 3) mathematics education studies that include students' views (or perceptions, stories, opinions, emotions); and 4) disability studies that include students' views (or perceptions, stories, opinions, emotions; see Figure 1 below).

Figure 1

Key Areas for the Literature Search
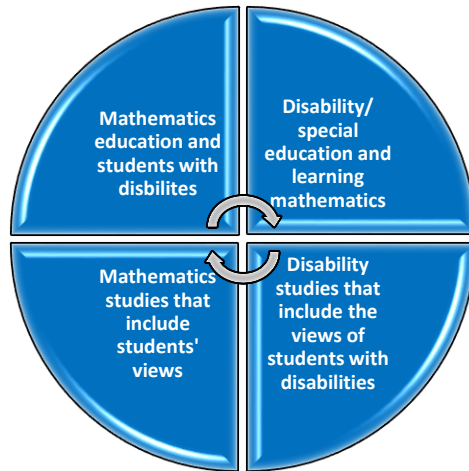
Each thread resulted in the following number of articles and its matching selection: 1) 305 results of which 16 were selected; 2) 195 results of which 25 were selected; 3) 1089 results of which 48 were selected; and 4) 1513 studies of which 34 were selected for further analysis. I reviewed the abstract of a total of 216 articles looking in particular at the four theoretical bound threads and combinations of keywords from Figure 1.

Studies were selected if the sample included students with disabilities in an inclusive setting from secondary education (9th to 12th grade) or close related ages (7th-8th grade to first year of college); the study included students' perceptions, views, opinions, stories, and/or experiences; the study was related to or included mathematics education; and the article was published in a peer-reviewed journal in English. Duplicated papers were excluded in addition to papers that focused on teachers' education, professional development, or interventions. After the selection criteria was met, I retained 46 of them for further in-depth analysis.

In addition to scholarly articles found through online databases, I examined a series of seminal books of relevant authors in the area of research methodology (i.e., Creswell, 2010,

Glense, 2006; Stake, 1995), conceptual frameworks (i.e., Vygotsky, 1962, 1978), and education (i.e., Merriam, 1998). Additional books and articles mentioned in these sources were selected if the work and/or the names of the researchers appeared in several books/articles; some citations captured unique, relevant, or supplementary ideas related to the study; and some theories were adopted or adapted from other investigations.

Student's Characteristics and its Impact on Learning Mathematics

Different cognitive, social-cognitive, personality, motivational and emotional variables have been investigated in education and psychology studies in an attempt to uncover "the key" to academic success or difficulties in learning thereof (Chandra, R. & Azimuddin, 2013; De Lourdes Mata at al., 2012; Heaven & Ciarrochi, 2012; Propat, 2009). IQ testing, for example, held predominance in measuring students in terms of cognitive ability as well as for identification and placement purposes into different special education models (Hendrick & MacMillan, 2001). Some personality traits such as conscientiousness (Noftle & Robins, 2007) and persistence (Lounsbury et al., 2009) have been found to be strongly correlated to academic achievement, even when IQ was controlled for. Other studies approached self-concept, self-esteem, self-efficacy, self-regulation, habits of the mind, and mindset, and analyzed their effect on academic performance either independently or together, in comprehensive models (Bandura, 1993; Boekaerts, 1996, 1999; Dweck, 2016, Pintrich & De Groot, 1990). A significant corpus of research focuses on mathematical anxiety (Mutodi & Ngirade, 2014; Tobias, 1993) defined as feelings of tension, apprehension, or fear that disrupts cognitive processing of information by compromising working memory and the higher order thinking necessary in complex tasks (Ashcraft, 2002; Ashcraft & Kirk, 2001). Neuroscience and genetics went in further depth to

analyze the chemical and anatomical makeup of the human brain and its influence on educational achievement (Lee, 2008).

Of the cognitive factors that impact mathematic performance, a majority of articles focused on working memory, attention, motivation, learning strategy, cognitive strategy, and self-regulation (Boekaerts & Cascallar, 2006; Musso et al, 2012; Ordaz-Fillegas et al., 2013). The same cognitive factors are central to disability studies. Geary (2004), for example, focuses on memory and cognitive deficits that interfere with the ability to learn concepts or procedures in one or more mathematical domains. "Competencies in any given area of mathematics," Geary (1994) states, "will depend on a conceptual understanding of the domain and procedural knowledge that supports actual problem solving" (cited in Geary 2004, p. 8). Most studies that include students with disabilities focus on their weaknesses, such as difficulties on working memory, hyperactivity, or foundational mathematics skills (Kofler, et al., 2009; Montague, & van Garderen, 2003; Powel et al., 2013; Rapport et al., 2009).

Vulnerabilities of Students with Disabilities that Impact their Learning

Although studies tend to bundle students with disabilities under one umbrela (Chesmore et al., 2016; Lackaye & Margalit, 2006; Montague & van Garderen, 2003), in actuality disabilities manifest within 13 eligibility categories as highlighed by IDEA (Yell, 2012, p. 67). Moroever, students that are identified as belonging within the same label are heterogeneous exhibiting different vulnerabilities and assets. As such, both reading disability and mathematics disability enter in the category of Specific Learning Disability (LD), yet affect students' learning in different ways. Just in considering memory, for example, disability can affect one area or more concurrently in terms of a student's memory processes such as encoding, storage, or retrieval;

and/or one's memory systems such as short-term, long-term, visual, or auditory memory (see DuPaul & Volpe, 2009 for an example of memory deficits in children with ADHD and LD).

The National Center for Education Statistics (NCES, 2019) indicates that the total number of students with disabilities ages 3-21 receiving special educations services under IDEA during the school year 2017-2018 was 7 milion or 14% of total U.S. public school enrolment. The eligibility category with the highest incidence, accounting for 34%, is Learning Disability. Recently, other disabilities show an increase in occurrence such as Autism Spectrum Disorder (ASD) and Attention-Deficit Hyperactivity Disorder (ADHD; Gage at al., 2012; Kim et al., 2011), representing 10% and 14% respectively out of the total public-school special education population in the U.S. In addition, many students with ADHD and ASD might go undetected and unaddressed in the mainstream school population (Kim et al., 2011).

Any disability can manifest separately or co-occurring, showing comorbidity of symptoms from different disabilities. Some students with ADHD, for example, can also present with a learning disability (DuPaul & Volpe, 2009, Schones et al., 2006, Willcutt et al., 2010) or students with autism could display ADHD indicators (Leitner, 2014). At times disability overlaps with other educational categories. As such, some English Learners (ELs) might display a LD as well. EL-LD students are at a higher disadvantage than students that are solely identified as LD or EL and show a higher achievement gap than either group on its own (Solari et al., 2012). They are usually receiving services through special education. Unfortunately, few teachers are conversant in language acquisition to be able to support appropriately the development of EL-LD students (Klingner et al., 2006). Some gifted students might display a disability as well (i.e., LD, ADHD, or ASD) – these cases are referred to as twice exceptional learners (Reis et al., 2012). Although many qualitative studies amass students with disabilities into a single category and

often compare them as a group to non-disabled peers (Chesmore, et al., 2016; Lackaye & Margalit, 2006; Schulte & Stevens, 2015), the profile of a single learner taken individually is rarely a perfect overlap with the theoretical profile of any specific disability (Lambert 2015, 2017).

Vulnerabilities of Students with Learning Disability in Learning. Specific Learning Disability (LD) is the category with the highest incidence among school age children served through special education services in general education classes (Schnoes et al., 2006). The definition of a LD in the U.S. is,

> A disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations. (IDEA, 2004)

> LD was initially conceptualized as a discrepancy between student's intelligence scores (Full-Scale IQ and its Verbal, Non-verbal, and Quantitative Subscale scores) and his/her lower than expected achievement scores, both measured through normed, standardized psychological tests (Geary, 2004; Lambert, 2017). LD is, therefore, envisioned as a contrast between student's potential set against difficulties in learning at a level commensurate with his/her intelligence. Furthermore, LD can affect any of the cognitive processes (i.e., memory, executive functioning, or processing speed) which in turn can affect in different ways one or more academic domains. More recently, other assessment strategies have come to be regarded as more representative of the way in which students are identified by seeking to eliminate cultural and linguistic bias associated with IQ scores, such as response-to-intervention (RTI) and the determination of a pattern of strengths and weaknesses (Schultz et al., 2006).

Geary's studies (2004, 2011) reviewed the literature on Mathematics Learning Disability (MLD) or discalculia. He investigated in particular memory and cognitive deficits that interfere with the ability to learn concepts or procedures in one or more mathematical domains. "Competencies in any given area of mathematics," Geary (1994) stated, "will depend on a conceptual understanding of the domain and procedural knowledge that supports actual problem solving" (cited in Geary 2004, p. 8). In addition, the author highlighted the impact on mathematics competencies of disruptive functions of the central executive (i.e., attentional and inhibitory control of information processing) and further, of the language system and of the visiospatial system through information representation and information manipulation. A poor understanding of the concepts underlying mathematical procedures was indicated as problematic in the studies reviewed by the author. Geary (2004) concluded that,

> Many of these children have an immature understanding of certain counting principles and, with respect to arithmetic, use problem solving procedures that are more commonly used by younger, typically achieving children. They also frequently commit procedural errors. For some of these children, procedural skills, at least as related to simple arithmetic, improve over the course of the elementary school years, and thus, the early deficit may not be due to a permanent cognitive disability. At the same time, many children with MLD also have difficulties retrieving basic arithmetic facts from long-term memory, a deficit that often does not improve. (p. 13)

In general terms, students with LD can present cognitive difficulties in different areas. For example, Fullarton and Duquette's (2016) qualitative study included four college students with LD. The first participant manifested weakness in short-term memory, visual-motor integration, visual processing, and Asperger's Syndrome. The second participant was diagnosed

with dyslexia. The third displayed poor eye-hand coordination and processing problems. The fourth exhibited working memory difficulties, processing delays, and problems with reading comprehension. Thus, each student with LD might display a unique profile of vulnerabilities that impacts their academic achievement.

Vulnerabilities of Students with Autism Spectrum Disorder in Learning. Autism Spectrum Disorder (ASD) is considered a neurodevelopmental disorder. It is characterized by persistent difficulties in social communications and interactions across multiple contexts and by restricted and repetitive patterns of behaviors, activities, and/or interests. The symptoms need to be present in the early development period and not caused by intellectual disability or global developmental delay (American Psychiatric Association Diagnostic, 2000). Those two behavioral dimensions, difficulties in communication and restricted behaviors, are the prevalent indicators of a possible autism disorder. Associated dimensions such as intellectual and language ability represent differentiation characteristics that indicate the heterogeneity of autism (Ousley & Cermak, 2014; Whitby & Mancil, 2009). Furthermore, autism can present co-occurring symptoms of ADHD, disruptive behaviors, anxiety and depression (p. 5). Looking at intelligence, autism is classified into low-functioning and high-functioning categories. Since typically only high-functioning autistic students (HFA) are included in general education classes, the current study will focus on their characteristics. Students with HFA are considered as having a full-scale IQ of 80 and above (Mayes et al., 2009; Whitby & Mancil, 2009).

After reviewing the literature from 1981 to date involving ASD (i.e., high functioning students with ASD) and academic achievement, Schaefer et al. (2009) found only five articles on which the academic profile of students with autism was the primary area assessed. Overall, the review of the literature suggests that students with autism have vulnerabilities in the areas of

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reading and listening comprehension, written expression, graphomotor and organizational skills, attention, linguistically complex materials, complex processing across all domains, and problem solving and numerical operations (p. 556). Those vulnerabilities in general impact reading, writing, and/or mathematics.

Regarding mathematics, the studies reviewed by Schaefer et al. (2009) indicate that students with autism have average mathematical ability, however they might struggle with applied problems and also with multiple-step problems due to organizational and attention vulnerabilities. Those difficulties might account for the significant difference between average to above average IQ and average mathematical ability findings. "Given the heterogeneous nature of the disorder," the authors state, "huge range of functioning across students may exist" (p. 558).

Goldstein et al. (1994) compared 64 students with High Functioning Autism (HFA) to 64 medically and neurologically healthy students, with similar characteristics regarding age, gender, intellectual level, race, and socioeconomic status. Their findings indicate a discrepancy between younger and older students with HFA (the cut-off age was 14). Students' academic history shows similar attainment as their typically developing peers till a certain age when a decline was observed in cognitive development such as in memory, linguistic, and problem-solving capacities. The authors attribute this decline to the impact of adaptative behaviors which in turn influences their academic development relative to same age peers (p. 678).

Estes et al. (2010) studied the relationship of academic achievement, intellectual ability, social ability and problem behavior in a sample of 30 high-functioning, 9-year-old students with autism. All students received an initial diagnosis between ages 3 and 4; and their nonverbal IQ at 9 was over 70 (on a scale where 85 to 115 is average; Ortiz & Lella, 2004). Twenty-five children in the sample were boys and 70% white. The authors found discrepancies between academic

achievement and intellectual ability as either higher or lower than expected. Twenty-seven out of 30 students (90%) demonstrated at least a discrepancy in spelling, word reading, or basic number skills. A notable finding was a high number of children (18 out of 30 or 60%) had at least one area higher than predicted achievement. Additionally, children's social skills level at age 6 predicted their word reading proficiency at age 9. Problem behaviors did not have an impact on the level of academic achievement. The results of the study attest the heterogeneity of vulnerabilities and assets of students with ASD.

Vulnerabilities of Students with Attention Deficit Hyperactive Disorder in Learning. Some disabilities are more likely to be detected early, such as the more severe variants of intellectual disabilities, autism spectrum disorders (ASD), motor disorders, tic disorders, and communication disorders. Other disorders, however, like specific learning disorders (LD) or attention deficit/ hyperactivity disorder (ADHD) have been called the "hidden disabilities" (Wolfe, 2001) because they are not obvious disabilities and often are detected only after significant failure has been experienced by the learner. ADHD requires a medical diagnosis given by a pediatrician. Like ASD, it is considered a neuropsychological disorder and has some overlapping phenotypic characteristics (Leitner, 2014). ADHD is associated with persistent academic underachievement, poor mathematics and reading standardized test scores, recommendations for taking remedial classes, and repeating a grade (Leo & Feldman, 2007).

Schnoes et al. (2006) examined the characteristics, prevalence, and services offered to students with ADHD that received special education services. The authors used a large sample of individuals randomly selected from 14000 students within a 5-year data collection period. They used, therefore, a nationally representative sample with regards to stratification by geographic region, district size, and district wealth. The students were ages 6 to 12, with reported presence

or absence of symptoms at home and at school, and selected from different disability categories (i.e., Other Health Impairment or Emotional Disturbance). Parents and school agreement differentiated the sample of 467 (33%) students with ADHD served in special education and 952 (67%) without ADHD (non-ADHD group). The results of their analysis suggested that special education students with and without ADHD were disproportionally male. The parents reported in about two thirds of them (69.2%) to be taking stimulant medication. Almost two thirds (68.5%) of the students with ADHD from the sample were placed in the Other Health Impairment category (OHI) based on limited alertness difficulties. Almost the same percentage was found in the Emotional Disturbance category (60%) due to refractory behaviors and/or co-occurring psychiatric disorder such as anxiety and oppositional defiant disorder. Approximately one fifth of students with Mental Retardation (MR) or Learning Disability (LD, about 20%) and only 4.5% classified as Speech-Language Impairment (SLI) had ADHD. The most common disability manifested by students with and without ADHD was LD. Approximately half of individuals with ADHD were served under LD category.

The majority of both, ADHD and non-ADHD special education students, spent most of their time in general education classes. Both groups received academic services although students with ADHD received significantly more often than non-ADHD peers (91% vs. 80%; Schnoes et al., 2006, p. 490). There was no difference in the frequency of modified grading standards, tests read to students, alternative tests, and slower paced instruction. Medication is in general considered equivalent or better than behavior modification management interventions (Leo & Feldman, 2007).

In terms of cognitive difficulties, Rapport et al. (2008) investigated the connection of central executive as a general domain and working memory subprocesses in ADHD versus non-

ADHD students. The sample consisted of 23 boys, 12 with ADHD and 12 typically-learning, with a full-scale IQ score higher than 85 (age 8-12). Working memory is documented as "the cognitive ability to temporarily store and mentally manipulate limited amounts of information for use in guiding behavior" (p. 825). The center executive represents the attentional (e.g., ability to maintain attention) and inhibitory control of information processing (e.g., poor inhibition of irrelevant associations). In other words, "disruptive functions" (Geary, 2004, p.13) of the center executive may impact the ability of ADHD students to screen out irrelevant data (inhibitory function) with difficulties to represent and manipulate information (attentional function) in the language system. In their study, Rapport et al. (2008) looked at two subcomponents of working memory regulated by the central executive as an attentional controller. The subcomponents were phonological (verbal) and visuospatial (nonverbal) storage and rehearsal.

The results of their study show that phonological working memory was significantly better developed relative to visual-spatial abilities regardless of the group membership. However, each domain was lower for ADHD children relative to the typically developing peers of similar age and intelligence. The authors noticed that the differences were seen even on the lowest working load tasks and become more noticeable as the memory load increased. Rapport et al. (2006) attributed those problems to "an underlying impairment in the buffer (storage)/rehearsal loops functioning in both subsystems" (p. 834) as well as to a lack of metamemory conscious strategies that can help students with recall when the working load is increased. Their results show the critical role "played by the central executive in directing and focusing attention" (p. 834) which appear impaired in individuals with ADHD. Vulnerabilities consistent with working memory functioning have a negative impact in all areas of a child's academic achievement.

A newer concept in the study of ADHD is understanding of emotional dysregulation. Neuropsychological tests of emotional control regarding impulsivity, self-regulation of positive and negative emotions, and executive functioning appear impaired in individuals with ADHD. Van Stralen (2016) indicated that "most descriptions of emotional dysregulation in ADHD include the concepts of an inability to modulate emotional responses and excessive reactions to a particular emotional trigger that would be considered inappropriate for the developmental age of the individual and the social setting" (p. 185). The responses of ADHD individuals to emotional stimuli can manifest either by internalizing them in the form of withdraw or sadness, or by externalizing them in behaviors that appear aggressive and argumentative.

As the literature indicates (Leo & Feldman, 2007; Schnoes et al., 2006) ADHD characteristics, intervention strategies, and the impact on academic achievement is difficult to study and assess due to coexisting conditions and their inclusion into different disability categories. In addition, most studies involving children with ADHD are published in specialized journals (i.e., Journal of Abnormal Child Psychology or Journal of Pediatric Psychology) and therefore are harder to access by teachers even when they involve interventions that could help them reach students with ADHD (see DuPaul et al., 2006; Leo & Feldman, 2007; Rapport et al., 2006).

Students' Assets in Learning

Strengths-based perspectives and models of practice and inquiry have been recently introduced through the counseling, mental health, therapy, psychology, and social work fields (Cox, 2008; Dybicz, 2011). Cox's (2008) study, for example, emphasized the tendency of health professionals to focus on a comprehensive assessment of youth's problems (including environmental and family) and establish goals and interventions to remediate areas identified at

risk. Although strengths-based assessments and interventions are available, the practitioners continue to focus on the "assessment of disorders and deficits required in the establishment of medical diagnosis necessity for services" (Cox, 2008, p. 19), a practice that parallels the process of identifying and evaluating students with disabilities for special education services. A substantial amount of studies concerning students with disabilities in an inclusive setting focuses on vulnerabilities (i.e., processing, memory, attention, executive functioning, organization, emotional, social, and related academic weaknesses; see for example Gary, 2004) and interventions to remediate those vulnerabilities (Geary, 2011; Marita & Hord, 2017) while assets are seldom acknowledged and used in the classroom to boost students' success. Similarly, research on trauma and negative life events focused in the past on individuals' vulnerabilities to explain the experiences that make people susceptible to poor life outcomes (Konnikova, 2016).

The concept of resilience (Garmezy, 1971) was a major breakthrough as a way of uncovering the assets people rely on to achieve success despite initial challenges. Resilience was defined as "a child's ability to regain his/her shape after going through crises or adversities" (Gunnestad, 2006, p. 1). Garmezy's work (1971, 1991), therefore, opened the door to identify and study "protective factors," namely the elements of an individual's background and personal characteristics that could enable success despite the challenges he/she faces (Konnikova, 2016). For example, Werner and Smith's (1982) longitudinal-study suggests that one in three at risk children (i.e., children in any condition, circumstance, or event that increases the likelihood of a negative outcome in his/her life) grew into competent, confident, responsible, caring, and successful adults in all aspects of their lives.

Recent studies on education focus on revealing how protective factors or supports work to facilitate resilience in students with disabilities (Panicker & Chelliah, 2016; Yu et al., 2018).

Haft et al. (2016), for example, looked specifically at reading disability (RD). The authors operationalized the concept of resilience through two distinct facets, cognitive and emotional resilience. After reviewing a series of longitudinal studies (2009 – 2016) on potential protective factors that lead to resilience in pre-readers at risk, the authors found the following supportive assets: oral language skills, motor skills, high levels of task-focused behavior, executive functions, and interpersonal relationships. The cognitive protective factors for older children and adults were morphological awareness, vocabulary, verbal reasoning, executive functions, and grammar. In summary, for cognitive resilience in students at risk or identified as RD, oral language skills (e.g., vocabulary) appear to be critical for cognitive resilience.

In addition to cognitive resilience, the studies investigated by Haft et al. (2016) show that students with RD can exhibit socio-emotional resilience or "positive psychological adjustment despite risks presented by RD" (p. 1). The authors presented their findings grouped in three categories: 1) individual (i.e., growth mindset, hopeful thinking, sense of coherence, internal locus of control, and self-determination); 2) family (i.e., family cohesion, maternal affect, strong parental attachment, and parental support and understanding of RD); and 3) community (i.e., peer relationships, teacher support, mentorship, and small class size). Those results show that students with disabilities have assets and strategies that help them compensate for their vulnerabilities. Few studies however approach protective factors in studying mathematics, a subject that presents added complications as a discipline in itself.

Nevertheless, Brownlee et al. (2012) affirm, "resiliency can only exist when there are demonstrable risks" (p. 2) while a strengths perspective takes into consideration "children's resources and assets whether or not these resources and assets emerged in relation to challenges or adversity within a child's life" (Bawana & Brownlee, 2009 as cited in Brownlee et al., 2012,

p. 3). The authors consider strengths, personal skills and characteristics valued by both the

individuals themselves and society, therefore highlighting the value-laden, socially and culturally

mediated view on strengths or their lack thereof. The authors uphold,

> When the concept of strengths is harnessed and teamed with the resources that schools,
>
> families, communities, and individuals can offer, the result is often that students rise
>
> above their deficits, issues, and the labels that have been put on them, and that the
>
> resilience of everyone, and not only those who have already overcome the odds, is
>
> increased. (p. 9)

The assets of students with disabilities add to the plethora of cognitive, social-cognitive,

personality, motivational and emotional characteristics that contribute to all students' overall

school success. Besides resilience, therefore, each disability category and each student presents a

unique set of assets worth knowing and supporting. As Armstrong (2012) expressed, more effort

needs to be set forth into detailing the positive attributes of students with disabilities rather than

their "deficits" (p. 10). He further highlights that a "neurodiversity perspective" as opposed to a

disability one, would encourage our culture and society to construct "positive niches –

advantageous environments that minimize weaknesses and maximize strengths and thereby help

students flourish in school" (p. 13).

      The Assets of Students with Learning Disability in Learning. All students have assets,

including students with disabilities, even if they are considered relative. Schultz et al. (2006), for

example, understand LD as capturing difficulties in some areas which might be directly tied to

strengths in others. The authors describe, however, the method of identifying LD students by

looking at patterns of "strengths and weaknesses" and the triangulation method used to ensure

the validity of the findings. They do not present in their study particular assets and vulnerabilities of LD students.

The literature that investigate LD mainly focus on vulnerabilities (Montague & van Garderen, 2003), identification processes (Schultz et al., 2006), and interventions and/or teaching strategies (Marita & Hord, 2017). Information pertinent to the strengths of LD students can be transferred from studies that involve gifted students with LD. Baum et al. (2001) looked at gifted students with difficulties in reading, mathematics, spelling, handwriting, memory, sustaining attention, poor self-efficacy, and/or difficulties with organization. Through vignettes they documented the experiences of four students who displayed difficulties in writing or reading yet were able at the same time to learn complex information, to think abstractly, to engage in authentic problem solving, and to create original products to express their ideas (p. 480). The authors expressed,

> In all four cases, these students were able to accomplish complex tasks by circumventing their poor skills in reading and writing. Switching the focus away from these problematic areas for a time empowered the students to use other intelligences to solve problems and create products. As a result, their successes on tasks more complex than those typically used in remedial lessons boosted the students' self-efficacy and perception of their abilities as learners. In other words, accommodating the needs the students had as gifted learners helped them to compensate for their learning difficulties. (p. 481)

Baum et al. (2001) ask an important question: "How do teachers develop educational experiences that respect the abilities of these students while helping them overcome their learning problems?" (p. 481). The same question can be raised for students with LD who are not gifted. They do present strengths that wait to be discovered and capitalized upon in order to raise

their self-confidence and motivation to be socially involved and earn passing grades in school. Their strengths are ignored more so than the strengths of gifted students. The authors' statement – "the belief that these students' deficits must be remediated before any attention can be given to their abilities and interests often results in little or no attention to the students' gifts or talents" (p. 482) – is valid for all LD students. Transferring the characteristics of gifted students with LD, to all students with LD, a profile of learning difficulties, learning assets, and learning accommodations to address their assets can be drawn as shown in Table 1.

Table 1

Difficulties, Assets, and Accommodations (Adapted after Baum et al., 2001, p. 482)

Problems associated with LD	Students' assets and interests	Accommodations to address students' assets
Difficulties in reading and/or mathematics	Capitalize on students' real-life experiences and their interests	Alternate means to access information
Difficulties with spelling and handwriting	Need to communicate creative ideas and knowledge	Alternate ways to express ideas and create products
Language difficulties in verbal communication and conceptualization	Curiosity and striving to understand	Information is conveyed through visual and kinesthetic approaches
Poor organization	Often demonstrate unique ways of thinking and learning	Use of visual organization schemes (i.e., graphic organizers, timelines, flow charts)
Attention difficulties	Need for challenge in the area of interest	Interest-based authentic curriculum
Social interaction difficulties	Need to identify with others of similar talents and interests	Group identity based on talent or ability

The assets of students with LD, therefore, include knowledge gathered from their own real-life experiences and interests, a need to communicate ideas and knowledge creatively, curiosity and striving to understand, unique ways of thinking and learning, a desire for challenge in the area of interest, and a need to identify with other individuals with similar characteristics and interests.

Goldberg et al. (2003) approached LD longitudinally through an ethnographic investigation using in-depth interviews as a method of data collection. The sample consisted of

41 participants, over a period of 20 years (14 females). Their objective was to identify successful

qualities that predict success in the life of individuals with LD. Those qualities could be

considered possible assets that LD students use in order to compensate for their difficulties –

qualities such as self-awareness, proactivity, and perseverance. One component of self-awareness

– the ability to compartmentalize – differentiated successful from unsuccessful individuals with

LD. Although students were aware of their disability, they didn't let themselves be defined by it.

They were able to see personal assets that increased their self-esteem. In addition, successful

students had goals that were specific yet flexible. The presence and use of social support

contributed to a high degree to the success of LD individuals, showing a socio-cultural-historical

facet from which students can benefit. The students spoke frequently about the support and

encouragement provided by "significant others" (i.e., teachers or family; p. 228). All participants

in the study reported significant stress growing up with LD with constant struggles to be

successful which led to feelings of depression and anxiety even in successful participants. The

successful individuals learned coping strategies to deal with emotional stress. Developing and

maintaining good social relationships helped as a coping mechanism as well.

The participants in the study reported that adolescence was the period in which they

gained more control over their educational outcomes. They were able to pursue their interests

and talents, which allowed for more experiences with success. The authors stated that "successful

informants went on to say that, starting in adolescence, they prevailed not because they had

remediated their LD, but because they had capitalized on a special ability or interest to help them

achieve self-sufficiency" (p. 232).

The Assets of Students with Autism Spectrum Disorder in Learning. ASD students

(i.e., high functioning) can show a discrepancy between their intellectual level and higher than

expected level of achievement which indicate they might have some unknown strengths (Estes et al., 2010). Mottron et al. (2013) investigated "superior" qualities in students with autism. The literature reviewed revealed a high within-subject heterogeneity with peaks of performance in certain areas of functioning contrasting with vulnerabilities in other areas.

Chandler-Olcott and Kluth (2009) showed the benefits for all students in the classroom when children with autism are included in a general education classroom (p. 550). First, understanding the concepts being taught expanded by including new perspectives. Second, multiple ways of participating in classroom activities were sought and valued. Third, instructional planning focused on outcomes (what the students need to learn), not activities (completing an instructional activity). In other words, how to reach all students became a priority prompting teachers to improve their practice – "adjusting expectations, providing different kinds of support, offering more challenge where needed" (p. 553). And lastly, teachers are positioned as inquirers, constantly gathering data about individual students' strengths, interests, and needs in order to improve their approach to teaching. Chandler-Olcott and Kluth (2009) focused, however, on the benefits of an inclusive classroom not on the strengths of children themselves.

Grandin (2007) presents her position of an autist child from "the inside" (see also Grandin, 1981). In her opinion, what helps older students with autism achieve success is a teacher who supports them develop their strengths. She expressed that her particular quality was being a photorealistic visual thinker which helped her as a scientist. Some other autistic students might think in terms of visual or sound patterns instead of pictures and usually excel in music and mathematics. Still other students might think in terms of "lists of words and facts and often love history and sports statistics" (p. 31).

The author voiced that the skills of students with autism are uneven, and a better approach to encouraging them succeed in school is developing their strong areas as opposed to correcting their problems which may lead to stress. She recommended extracurricular activities such as involvement in school clubs for developing social skills while capitalizing on students' interests. "The secret to motivating students with autism," Grandin (2007) expressed, "is to broaden the students' fixations into useful activities" (p. 31). Being or finding a mentor in school was also of great help in her own development. Teachers who focus on the assets of students with autism, including extracurricular activities, highlight socio-cultural-historical aspects of school life and their impact on the academic and further career success of students with autism.

The assets of students with Attention Deficit Hyperactive Disorder in Learning. Students with ADHD are seen in general by parents and teachers as challenging behaviorally, socially, and academically. The students with ADHD, however, might present strengths invaluable for their own success as well as for society by-and-large. The characteristics of students with ADHD are present as in ASD, on a spectrum or continuum, implying that some aspects of ADHD might be "adaptive rather than impairing" and others might represent strengths used to compensate for ADHD related difficulties (Segwick et al., 2019, p. 241).

Climie and Mastoras (2015) sought to portray students with ADHD in a positive light, illustrating the necessity to take a strengths-based approach to understand and support them. The authors looked in particular at resilience and the protective factors that can help students with ADHD succeed. Those protective factors can be nurtured using students' strengths (i.e., a sense of belonginess, self-worth, and sense of responsibility). Those concepts, however, are general and have a significant role in supporting the learning and success of any student regardless of

his/her ability and/or disability. The authors did not present details as to what assets are unique to ADHD students.

White and Shah (2006) looked at the creativity of students with ADHD, as a unique characteristic. The authors tested 90 college students with and without ADHD on convergent and divergent thinking tasks. The results of their study show that indeed students with ADHD might have above-average divergent thinking ability. Interestingly, this ability is facilitated by the lower levels of inhibitory control, which is considered a significant vulnerability for individuals with ADHD. Difficulties in inhibitory control hinders convergent thinking while it facilitates divergent thinking or ''thinking outside the box'' necessary for creative activities.

In a different study, Fugate et al. (2013) looked at creativity and working memory in gifted students with and without characteristics of ADHD of the same intellectual ability or fluid intelligence. The sample of students consisted of 68 individuals grades 5 through 12. Their results revealed that gifted students with ADHD had lower working memory yet significantly higher creativity than those gifted without ADHD. "Indeed," the authors concluded, "the results of this study suggest that the combination of inattentiveness and hyperactivity contributes to creativity" (p. 243).

Sedgwick et al.'s (2019) research is illustrative in showing the specific strengths of individuals with ADHD. The authors used a phenomenological approach with open-ended interviews to collect data in order to find insights into the positive qualities that accounted for participants' success in school and in life. The sample consisted of six successful and flourishing adult males age 30 to 65 years old who had been recently diagnosed with ADHD and were prescribed medication. The data collected converged into six core themes, cognitive dynamism, courage, energy, humanity, resilience, and transcendence (p. 243). Those themes were compared

with "the attributes catalogued in the character strengths and virtues (CVS) handbook and classification of the 'sanities' in positive psychology" (Peterson and Seligman, 2004, cited in Sedgwick et al., 2019, p. 244) and thought to promote positivity and wellbeing.

From those themes, the authors found that four of them, specifically courage, humanity, resilience, and transcendence; and the attached subthemes, creativity, curiosity, bravery, integrity, persistence, spirit, enthusiasm, vitality, vigor, social intelligence, humor, self-regulation, appreciation of beauty and excellence, were relevant to all human beings. The other two core themes, however, of cognitive dynamism and energy, and the corresponding subthemes of divergent thinking, hyper-focus, nonconformist, adventurousness, self-acceptance, and sublimation were positive aspects specific of individuals with ADHD.

Individuals with ADHD acknowledged having cognitive dynamism described as "spontaneous and non-sequential thought processes, flashes of images, as well as episodes of intense mental focus" (p. 244). They used courage to confront their fears and face life's uncertainty. All participants positively attributed to ADHD high levels of energy and capacity for action. In terms of humanity, the participants perceived themselves as having the ability to easily connect with people in social situations and as having a positive mental outlook. The participants acquired resilience in order to cope and manage their ADHD on a daily basis. The last theme, transcendence, characterized the musical experience of one participant. Its main subtheme was appreciation of beauty and excellence.

Supports in Learning Mathematics

Butrymowicz and Madar (2018) stated that, in the opinion of experts, "up to 90 percent of students with disabilities are capable of graduating from high school fully prepared to tackle college or a career if they receive proper support along the way" (p. 1). Those "proper supports,"

however, constitute a wide variety of elements from trained and caring teachers, to using differentiation strategies, and to available financial and human resources.

Cultural, Social, and Financial Support

DuPaul et al. (2006) examined academic interventions for students with ADHD and their effects on reading and mathematics achievement. The sample in their study consisted of 175 children in 4th grade (133 boys, 42 girls, 58% White, 26.9% Hispanic, and 14.4% Black) identified with ADHD symptoms by both their parents and teachers. The students were assigned randomly to one of two groups, Individualized Academic Intervention or Generic Academic Interventions. The type of intervention yielded no significant difference in students' behavior and achievement however, "positive growth trajectories were obtained for math and reading skills as well as teacher ratings of academic enablers (e.g., motivation, study skills) across a 15-month period" (p. 11) of intense consultation conducted by 11 doctoral students. DuPaul et al.'s (2006) study simply shows how social support is important, not the intervention type, in helping students flourish. Indirectly, it highlights the social aspects of learning and the positive results of care and consideration catered to the needs of students.

Bargerhuff's (2013) study corroborates the impact of cultural, social, and financial support in raising children's performance. The author looked particularly into the access and support of students with disabilities in STEM curriculum, including in rigorous mathematics classes. She based her literature review narrative on Marino's work (2010) which reveals that although 70% of students with disabilities fail to show proficiency in STEM subjects, versus 38% of typically developing students, they can "achieve at levels comparable to peers if given the right educational environment including teachers who effectively implement research-based practices" (p. 4).

The author employed a qualitative single-case study research methodology using semi-structured interviews, observation, and document analysis, to elicit the perspectives and experiences of faculty and staff on the inclusion of students with disabilities in general education classes, from a newly opened STEM school. All students came from different schools and started the year with different levels of proficiency and knowledge. Most 9th grade students with disabilities enrolled included either learning disability (LD) or autism spectrum disorder (ASD). The school integrated in its mission statement five qualities: persistence, inquiry, communication, creativity, and collaboration, which were consistently modeled in the classroom by teachers (p. 6). As an end of year culmination project, the students constructed a digital portfolio including evidence for the five qualities. All students participated in inter-disciplinary, authentic, real-world experiences with practicing scientists, engineers, and other professionals in research industry.

The findings were gathered on three categories. The first one related to teachers' ownership in supporting all students as "a labor of love" (p. 10). Most teachers reported that student with disabilities were not more demanding than their peers rather, "they all have their own challenges" (p. 11) and both general education and special education teachers took responsibility for the learning of all students. A mathematics teacher expressed that the rigorous pace of the curricula was "hard" for some students, yet she was still responsible for implementing differentiation strategies in order to reach them. Additionally, she personally wrote individualized goals for all students in her class and tracked data on those goals (p. 11), a practice that shows that every child would benefit from learning goals, not just those identified as having a disability.

The second category looked at possible challenges inherent to teaching a rigorous STEM curriculum. The teachers believed that their use of inquiry, project-based, real-word applications was helpful for all students. In addition, the teachers viewed students with disabilities as "having the necessary cognitive ability to learn the material and, in some cases, they judged those students as superior to those not identified with a disability" (p. 12). Some of them needed more help in doing group work, some had difficulty with the classroom noise level, others needed more structure in order to manage their workload, yet others had difficulties with the pace and the content of the curriculum requiring modifications in addition to accommodations. However, most teachers expressed appreciation of students' strengths and unique ways of thinking. They approached challenges with an "attitude of inquiry and set out to 'solve the problem'" (p. 13).

Supplementary funding helped the school provide Notebooks to all students (i.e., personal tablet). As such, those who required being read to could access during class the reading option using headphones. Another student with writing difficulties benefited from dictation software. They were delighted to show others how the software worked. In a Language Arts class, the teacher used Socratic inner and outer circles and dialogue/monologue sessions and to her surprise, students with disabilities often volunteered and took the lead in such activities (p. 14). The teachers put forth a lot of effort to get to know their students from their previous teachers and met individually with each. Besides academic content, additional skills that facilitate learning garnered support, such as cooperative learning, self-determination, and organization skills.

The third category revolved around the flexibility quality necessary to teach diverse students. As the teachers focused on the most important features of teaching and learning, students' needs and students' achievement, they were compliant with the IEP process and able to

implement ways to accommodate the learning of all students. The teachers worked cooperatively, each with equal voice in planning the curriculum and in making important decisions about school activities. The special education teacher was solicited for insights into the learning of students with disabilities. The main question that the study addressed was: "What cultural and instructional elements are useful in meeting the needs of students with disabilities in a STEM school?" (p. 17). The answer might seem to be common sense. Both teachers and students assumed "ownership for their own and others' learning and appreciated one another's strengths while accepting their differences" (p. 17).

In terms of instruction the most important component was represented by the teachers who found ways to balance "their dedication to academic content with their understanding of individual student characteristics" and who "displayed the flexibility necessary to maintain high expectations while incorporating reasonable accommodations and modifications" (p. 18). The school was designed and developed by partners from P-12 and higher education, businesses, industry, government, and community, and supported in part through grant funding (p. 6). Baregerhuff's work (2013) therefore, provides evidence that with the right cultural, social, and financial support students with disabilities can achieve within a demanding STEM curriculum.

Support from Nonacademic Coursework and Extracurricular Activities

Shifrer and Callahan (2010) investigated whether accumulated nonacademic coursework is associated with unique benefits for better supporting mathematics and science education. The authors used data from the National Center for Education Statistics (NCES), gathered during spring term of 2002, from 10th graders enrolled in approximately 750 high schools. Their sample, after the exclusion criteria had been met, included 530 students with LD and 9300 without LD out of a pool of 16,373 students. The study was longitudinal and quantitative, and

used bivariate statistics and regression models. The research controlled for the influence of male, nonwhite, living with both biological parents, having low socio-economic status (SES was captured with indicators of highest level of parental education and family income), and the 9th grade mathematics course level on academic outcomes.

The findings of their study suggest that in contrast to non-LD students, those identified with LD (i.e., had an IEP in place), were significantly disadvantaged along every measure of high school course taking and key STEM outcomes. The proportion of students identified with LD who progressed through Advanced Algebra or higher by 12th grade (22%) was significantly lower than the proportion among non-LD students (69%). Similarly, whereas 58% of non-LD students completed Chemistry by the 12th grade, only 16% of LD students did. In addition, students identified with LD earned significantly fewer credits (12.70 vs. 15.82) in academic core courses (i.e., math, science, social studies, language arts, and foreign language), and significantly more credits in non-core courses overall (10.21 vs. 8.54) by the 12th grade (p. 70). The odds, therefore, of completing Chemistry and Advanced Algebra or higher by 12th grade were significantly lower for students identified with LD – both of which are associated with higher rates of college admission. For example, Morgan et al.'s (2018) findings suggest that students who take "gateway" mathematics courses (i.e., Advanced Algebra and higher) are 3.2 times more likely to persevere and graduate from college than a student who took no gateway mathematics classes (p. 11). Mathematics college preparatory coursework, therefore, impacts students' participation in college enrollment, persistence, and graduation from postsecondary education. The authors stated,

> Our findings support a distinction in postsecondary outcomes between students that did
> and did not participate in college preparatory coursework during high school. Because the

differences in student demographics such as gender, socioeconomic status, and race/ethnicity were not significant, the data further supports the determination that college preparatory coursework is effective in diminishing disparate and adverse outcomes for students who are traditionally under-represented in postsecondary educational settings. (p. 15)

Shifrer and Callahan's (2010) results indicate that credit accumulation in technology and communications, liberal arts, and visual and performing arts coursework was significantly and positively associated with progression along both science and mathematics course-taking pipelines for all students. In contrast, credit accumulation in business, marketing, and distribution or agriculture, trade, and industry coursework had a significant and negative association with STEM course taking. Among students who completed no credits in technology and communications coursework, the predicted probability of completing Advanced Algebra or higher by 12th grade was 0.74 for non-LD and 0.27 for LD students. Instead, the predicted probability of completing the same mathematics classes increased to 0.84 for non-LD and 0.64 for LD students who completed 3 credits of technology and communications coursework. After analyzing the emerging patterns in the data, Shifrer and Callahan (2010) concluded,

Findings from the present study suggest that educators and schools can begin to address these inequities in very real ways through course placement. The persistent and sizeable gaps in STEM attainment between students who were and were not identified with LD, regardless of technology and communications credit accumulation, demonstrate the relevance of exploring students' course taking patterns. Students with LD are often identified when they fail to respond like other students to standard curriculum and pedagogy. As a result, locating coursework that benefits students who are identified with

LD to at least a comparable extent as students who are not identified with LD is a notable and worthwhile endeavor. (p. 72)

Blomfield and Barber (2010) examined the extracurricular activity participation and its impact on academic performance and overall development (see also Barber et al. 2003). Their sample consisted of 98 high school students, between 15 and 18 years old. The students were provided a detailed list of activities (i.e., team sports, individual sports, school involvement, performance, and community) from which they were asked to circle in which they are involved. Two of the questions were open-ended. Their activity was compared to academic track, future intentions, feelings of school belonging, risk behaviors, and peer characteristics.

Of the students who participated in extracurricular activities, 88% indicated involvement in activities made school more enjoyable, experienced less stress, and were less likely to skip school. Some students (46%) considered that the extracurricular activities influenced who their friends were, while others (40%) said it did not. The students that participated versus the ones that did not, were more likely to have high personal aspirations and to be on a college track. The authors concluded that "like the context provided by family, school, and peers, extracurricular activities form a crucial context of adolescent development" (p. 126). In addition, the characteristics of their friends were found to mediate the association between the participation in an extracurricular activity and developmental indicators.

Socio-Cultural-Historical Construction of Ability and Disability

Since any individual presents a set of assets and vulnerabilities in learning, the question that can be raised is to what extent are ability and disability socio-cultural-historical determined. The supports offered by the educational system and by each school independently to students with versus without disabilities impact their success (i.e., school culture, financial and human

resources allocated, or access to nonacademic classwork and to higher-level academic classes). Other socio-cultural-historical considerations that could influence the view of students with disabilities as competent learners are the pedagogy used in the classroom (Lambert, 2015, 2017), existent socio-cultural-historical myths (Lambert, 2018), the way the school system clusters students and evaluates them on different subgroups (Stevens, et al., 2015), and the way the students with versus without those disabilities are conceptualized and studied (Lambert & Tan, 2016, 2017).

Although students with disabilities might manifest true hardships related to the mathematics calculation (arithmetic) domain and/or conceptual and problem-solving domain, the impact of their difficulties can be more or less prominent depending on the general approach to mathematics instruction they experience. For example, programs that emphasize mathematics as a scientific field is heavily geared toward mathematical procedures and concepts at the expense of a deep understanding of the applied implications in real-life. Other mathematics courses underscore the application of mathematics in context at the expense of procedural and content exposure and proficiency (Geary, 2004). Students with disabilities, therefore, may or may not perform on level with typically developing peers depending on the intersectionality between their characteristics and interests, their learning needs and preferences, and the pedagogy approach of the teacher.

Lambert's (2015) study is significant in illustrating the construction of "ability" and "disability" according to teachers' instructional approach to teaching mathematics. She used a case study ethnography and interview approach to unravel how two 7th grade Latino/a children with learning disabilities, of poor economic background, positioned themselves as mathematics learners within different pedagogical discourses. The classroom team teachers shifted the

pedagogical emphasis from a discussion-based, critical thinking prominence in the first semester, to a procedural routine in the second part of the school year, to accommodate for the pressure of preparing students for standardized testing.

The inquiry followed two students with disabilities (i.e., with an IEP), Luis and Ana, as they built their identities, in a dynamic, conflicting at times way, wedged by the classroom pedagogical discourse. As such, Luis flourished as a creative thinker in a problem based, open-ended, divergent oriented, solution quest type of environment. His strength lied in his mind's ingenuity and his ability to talk through conceptual problems. For example, he used for computation purposes the analogy between the number line and the border between U.S. and Mexico. During the second semester, however, resisting the procedural, slow-paced, memory-based shift in pedagogy, he was demoted from a top student, to the "unsmartest group" (p. 1). Luis was named by his special education teacher a "behavior" problem and sent in the hallway every time he chose to work independently or with a peer, instead of following her lead and step-by-step instruction. Unlike Luis, Ana showed serious difficulties in conceptual mathematics and during the second semester advanced to the honors roll due to her intense focus and high effort in following new procedures. Persistent practice following a concrete set of instructions was her asset. Lambert's (2015) ethnographic case study exemplifies the impact of instructional strategy in triggering different learning vulnerabilities in students. In addition, as Lambert (2013) expressed "the cultural practices of schooling and sorting children, here the intersection of high-stakes testing, special education and tracking, not only reflected, but constructed certain ideas of ability and disability" (p. 408).

In another study, Lambert (2018) dismantled the myths that circulate in our society about students with LD (as of any other disability category), namely that 1) they can only benefit from

explicit-based and not from inquiry-based instruction and 2) they cannot construct their own strategies in solving mathematical problems and will not benefit from being engaged in multiple strategies. Referring to Luis, from her previous study (2015), Lambert (2018) expressed,

> These myths are predicated on the medical model of disability. When students with LD are understood primarily through their deficits, the solution from a medical model perspective is to remediate those deficits through targeted intervention. Students undergo treatments designed to fix them, in this case explicit interventions that will remediate the deficits. These deficit-focused arguments can be puzzling. Take for example the argument about memory, which suggests that students with LD cannot profit from inquiry-based instruction because of difficulties with memory. I agree that memory has often been an issue for many of the students with LD I have worked with over the years – sometimes a very pronounced issue. Using the medical model, we might assume that Luis has deficits in his memory which might have affected his ability to memorize the rules for adding and subtracting integers. But if his weakness is memorizing rules, why would we teach him through memorizing rules? Luis teaches us that he can use his strengths in visual processing to imagine a number line and use it to compute. Why would we not build on this, his unique strength? Focusing on deficits, rather than strengths, can be a counter-productive strategy. From this point of view, these myths are illogical, focused on remediating what challenges the learner, rather than building on their strengths. This will require a shift from a medical model, to neurodiversity, framing cognitive difference as diversity rather than deficit. (p. 8)

The grouping of students can function to increase or decrease perceived achievement gaps. It functions therefore as a socio-cultural-historical aspect of arbitrary classification of

students into "abled and disabled learners" (Lambert, 2015, p. 15). Schulte and Stevens (2015) examined mathematics growth using three different longitudinal methods for identifying the subgroup of students with disabilities (i.e., students determined each year, students determined in 3rd grade, and students identified between 3rd and 7th grade) and contrasted their achievement outcomes. The authors followed the mathematics attainment of a statewide 3rd grade cohort for 5 years (2001-2005) based on concerns that the criteria for which disability subgroups under NCLB were identified may not accurately characterize achievement gaps. Single versus multiple time point definitions of disability status may yield different descriptions of growth. Their sample contained 12% students with disabilities among which 16% were in special education at some time while 6% remained active in all grades.

The findings of Schulte and Stevens's (2015) investigation suggest that achievement gaps between students with and without disabilities were smaller when a stable subgroup of students with disabilities was examined – defined on the basis of special education membership at one point in time, rather than on a year-to-year basis. As the authors indicated, students that are successful exit special education, whereas students that experience difficulties enter. Special education performance as a subgroup, therefore, supports almost in exclusivity underperforming students. Consequently, the school system does not measure the proficiency level of all students with disabilities as a group, but rather a segment from it, represented by the academically struggling students from the group of students with disabilities, during each particular year. As such, the subgroup appears biased on the basis of an unjust procedural group designation.

In another study, Stevens et al. (2015) differentiated special education students on all exceptionality groups, intellectually gifted students, and general education students from a sample of 92,045 individuals. Among all students, 6951 were intellectually gifted and 14,694

were identified with disabilities. The authors evaluated students on their demographic characteristics as well. Students with disabilities included a higher percentage of males (20% fewer females), 12% higher participation in free and reduce lunch, and a higher percentage whose parents had lower education levels (10% had less than high school education). The results of the study suggest that "exceptionality group differences, especially initial status, are confounded to some extent by differential representation of exceptional students in particular socio-demographic groups" (p. 59). In addition, the results on mathematics standardized tests show smaller achievement gaps between students with disabilities and general education students when intellectually gifted students are considered separately.

Lastly, literature (Lambert & Tan, 2016, 2017; Schulte & Stevens, 2015) suggests a lack of consistency in methodology and conceptual framework in studying students with disabilities and their growth as opposed to students without disabilities.

Perceptions of Students with Disabilities and their Mathematics Learning

Critical Reviews and Meta-Analytic Studies

Lambert and Tan (2016) conducted a content analysis of 408 mathematics research articles focused on mathematics and PK-12 education published in 2013. In a follow-up study (2017), they included articles between 2013 and 2015. In both studies they focused on "how research on mathematical learning of children with and without disabilities differed in terms of academic fields, methodologies, mathematics content, and participants" (p. 1059). The results of the analysis indicated that research on students with disabilities were published preponderantly (90.5%) in special education or psychology journals. Articles that did not include disability, in contrast, were published mostly in mathematics education journals (68.3%). Likewise, mathematics journals published only two articles related to disability in 2013.

Research on mathematics learning of students with disabilities was overwhelmingly quantitative (83.3%) while only 9.5% of research was qualitative. On the other hand, students without disabilities were studied almost equally using a qualitative and quantitative methodology (40.2% versus 32.8% respectively; p. 1060). Further analyzing the age group of the learner included in articles, Lambert and Tan (2016) noted that most studies involving students with disabilities focused on elementary level learners (over 50%) while students without disabilities were evenly studied across ages and contexts.

Another major area of interest in their inquiry was the pedagogy involved in understanding students with and without a disability. In coding pedagogy, Lambert and Tan (2016) used Woodward's (2004) classification of pedagogies and its main characteristics, as it developed throughout the history of mathematics education and special education in the U.S. The categories described by Woodward (2004) are: 1) behaviorism (based on rote practice and memorization); 2) information processing (emphasized the processes behind learning; it represents the root for the conceptualization of processing deficits); 3) constructivism (new knowledge is constructed; emphasis is placed on the context); and 4) sociocultural (the current "dominant framework for understanding mathematics learning and instruction;" p. 21). To those categories, Lambert and Tan (2016; 2017) added the sociopolitical and critical theory as highlighted by Gutierez (2013), lenses through which mathematics education is seen as "part of larger social and political histories" with "inequities and/or privilege" that appears ingrained in the current educational discourse (p. 62). In addition, the authors noticed a significant number of articles that included learning as "mediated or controlled by psychometrics alone" and assigned to this pedagogical understanding the coding category "medical" (Lambert & Tan, 2016; p. 1060). The results of their analysis suggest that students with disabilities are typically

conceptualized in research through medical (16.6%), behavioral (23.8%), and information processing (19%) lenses. The students without disabilities, in contrast, were viewed through constructivist (23%), sociocultural (17.2%), and sociopolitical/critical (10.4%) lenses.

Findings from their follow-up study (2017) infer that mathematics problem solving studies focused on disability were predominantly published in special education and psychology publications (97%), none in mathematics education, and only one in general education journals. Articles including disability were predominantly quantitative (86%), two qualitative (6%), and one mixed method (3%). The articles on problem solving focused on non-disabled students were more evenly distributed (50% qualitative; 35% quantitative; and 4% mixed). In terms of theoretical lens, the problem-solving articles covering disabilities were understood through using information processing (31%), behavioral (22%), and medical (17%) lenses. The constructivist lens was used in a few studies (11%) and the sociocultural in one study. Problem solving for studies without a focus on disability, in contrast, were primarily understood through constructivist lenses (35%), with the second highest being sociocultural (19%).

The authors looked in deeper detail at the notion of "problem solving" which appeared with more prevalence in disability articles and which "are typically associated with procedural problem solving" (56% for the disability set versus 25% for the no-disability set; p. 12). Research involving problem solving for students with disabilities focused on schema-based pedagogy approach, which emphasizes explicit instruction, scaffolding of procedures, graphic organizers, and pre-determined, teacher-mediated steps to solve problems. The authors noted that the articles that focused on schema-based instruction were all quantitative in nature and reported results as aggregated test scores, with "no analysis of individual student mathematical thinking" (p. 12). Non-disability studies, in contrast, focused predominantly on "problem-posing" and in

using students' experiences and creativity in solving problems (i.e., student-directed, inquiry-based approach), and were coded as qualitative. Lambert and Tan (2017) question the "glaring disparity" in research methods where students with disabilities as opposed to those without disabilities are understood as a single category. The literature continues to treat them as "subjects to be studied as opposed to agentic thinkers" (Lambert & Tan, 2018, p. 129) and more often than not, dismiss their unique ways of learning mathematics, understandings that can benefit the scholar and education communities (Lambert & Tan, 2017; Tan & Kasper, 2017; Tan & Lambert, 2019).

Quantitative and Mixed-Methods Studies

LD students are often researched quantitatively and as a general group, suggesting that they would perform worse than typically developing peers. For example, Montague and van Garderen (2003) examined students' mathematics achievement, estimation ability, use of estimation strategies, and academic self-perception of 135 children amassed in three general groups: students with learning disabilities (LD), average achievers (AA), and intellectually gifted students (IG). The grades of the students were 4th, 6th, and 8th. Students with LD had a Full-Scale IQ of 85 or higher (measured by Wechsler Intelligence Scale for Children-Revised) while IG students' score was at least 130 on either Verbal or Performance IQ. The authors used a series of quantitative instruments among which were calculation, applied problems, and quantitative concepts subtests of a well-known psychological test (Woodcock-Johnson Psychoeducational Battery-Revised). The qualitative part of the study consisted of asking students questions about the estimation strategies used for the Estimation Multiple Choice Test.

Although Montague & van Garderen (2003) expected students with LD to hold lower self-perceptions of academic performance than their peers, the results indicated no difference in

self-perception between students with LD and average achievers. They also expected students with LD to perform lower on the estimation measures than their average achieving and intellectually gifted peers. The results suggested that even though students with LD used lower level estimation strategies than AA students, their estimates were as accurate. Both of these groups, however, performed significantly lower than their IG peers on these tasks (p. 443).

Students with LD and AA both had difficulties defining estimation through interviews, scoring at the very poor and poor levels, respectively. The IG students scored between good and very good on one of the instruments, particularly the Estimation Definition Task. The authors expressed that IG students, in addition to having higher ability, might also have had more experience with estimation in the form of exposure to tasks and situations that would require them to formulate estimates. This points to a social-cultural-historical aspect of teaching different groups of students including exposure to lower or higher-level estimation strategies that may lead to poorer or better performance respectively. Despite differences among ability groups, the findings inferred that all students did poorly on the estimation tests which might indicate a lack of reliability of the estimation instruments used in the study. Students with LD did not differ from their AA peers in their self-perceptions which implies that lower performance might be indeed the result of struggles on the part of LD individuals.

Qualitative Studies

A preliminary review of the literature revealed that students with disabilities are primarily studied through medical, behavioral, and information processing lenses and is focused on vulnerabilities, interventions, and diagnosis rather than on the learner himself/herself. Moreover, the studies looked at students with disabilities as a homogenous group and used predominately

quantitative research methods to analyze them, discounting as such each individual from the group as a unique and complex mathematics thinker and problem solver.

Lambert (2015, 2017) took upon herself to tackle the observed discrepancy between how students with versus without disabilities are conceptualized and studied. In two related longitudinal studies, she chose a qualitative approach and a critical sociocultural stance to inquire into students' perspectives on learning mathematics. The first article (Lambert 2015) focused on two 7th grade Latino/a students with disabilities, Luis and Ana from an inclusive mathematics setting. The results of the study suggest how their strengths and difficulties become apparent with the change in teachers' pedagogy style. Luis thrived in a discussion, critical-thinking oriented teaching and learning style while Ana struggled understanding the concepts. In contrast, Ana made the honor roll when the class switched to a procedural routine while Luis remained behind, demoted to the "unsmartest" group (Lambert 2015; p. 1).

In a second study, Lambert (2017) focused on another Latino student with LD, Elijah. Within the context of the classroom, Elijah perceived himself as both, fast and slow, and understood that he was being "judged by his ability to perform procedures either fast or slow" in an environment in which processing speed was used as a "proxy" for ability in mathematics. In Lambert's opinion (2016), Elijah "took up a decidedly different way of understanding himself as 'slow', not as a deficit, but as a difference" (p. 528). The following excerpt from the author's field notes is relevant in inferring that students with disabilities know what they need in order to be successful:

As I walked by this group, I felt that Elijah was disgruntled with Bobby, and I paused to watch their interaction. Bobby told Elijah that he needed to memorize the multiplication tables without using paper, because 'what if it is on the test.' After a pause, Elijah

forcefully told Bobby that he needed more time and also paper, because, in his words,

'I'm slow writing and [hand moves up to ear, made a circle] but I know them all. Just

pressure.' (p. 528)

Lambert's studies (2015, 2017) covered an observed gap in research – students with

disabilities are studied mostly quantitatively, as a group, with little attention given to their

individuality. More qualitative studies that address students' perspectives on their academic

learning experiences in an inclusive mathematics setting and the supports they need to be

successful are required in order to draw an accurate portrait of their needs and learning

preferences.

Students' Perceptions of Mathematics and Mathematics Learning

Students' perceptions of learning and school and the factors that influence such views are

continuously evolving with each generation and socio-cultural-historical developments,

therefore, a constant inquiry into their perceptions is a must. On the other hand, our society and

school system cannot provide appropriate supports for students without an inquiry into the wants

and needs as expressed by the students themselves. Few studies, however, focus on their

opinions and views. As Groves and Welsh's (2010) expressed, "students' insights are important

as a basis for their active and productive involvement, and where there is a serious intention to

improve students' learning" (p. 87).

Students' Voice

Grove and Welsh's (2010)' study filled this gap – of an under-representation of students'

perceptions in research investigations. The authors were interested in bringing to light what

students want, need, like and dislike about learning and their school experiences. Their sample

consisted of 14 students in 11th grade, studying at a high school in a suburb of Perth, Australia.

The authors administered first a survey that formed the basis for drafting questions for subsequent focus group interviews. One focus group consisted of 5 girls and 3 boys. The second of 4 girls and 2 boys. The themes and subthemes resulting from focus group discussions were related to meeting students' needs, listening to students' voice, teacher qualities, the relationships formed, and a sense of responsibility and control of the learning process. The students expressed that they wanted to see their interests and needs being incorporated into the curriculum and into daily lessons. They placed importance on learning activities that are varied and related to real-life situations. Students voiced their perceived value of school activities and experiences that are meaningful and interesting, and which provide opportunities for them to succeed both academically and developmentally. Another way in which teachers could acknowledge and incorporate individual interests and needs into the classroom was through one-on-one time and extra help for learners attempting to grasp more difficult concepts.

Participants agreed they benefit greatly from a combination of bookwork, such as textbook readings, worksheets, and written activities, and practical work, such as experiments and hands-on activities. The characteristics they sought in teachers were passionate and enthusiastic about teaching, with subject area knowledge; easy-going and having a positive outlook and a sense of humor; displaying honesty, confidence, trustworthiness, and respect toward students; and holding a teaching style that complemented the abilities of students. They all had a desire to be supported and encouraged by their teachers. They also acknowledged the influence of peers in learning – on the negative side, peers can be a distraction; on the positive one, they can provide a positive network of support. Although the two groups converged on their perceptions, they did show occasional divergence of opinions. For example, regarding future outcomes, one group was motivated in their schoolwork by short- and long-term personal aims

and ambitions; the second group instead valued money and used it as their ultimate goal for learning.

Young-Loveridge et al.'s (2006) inquiry is another example of a study focused on students' voice. The authors specified that "although children spend a lot of time doing mathematics, we know little about how they view the mathematics they do" and "in recent years, many writers have drawn attention to the importance of talking with and listening to students, in order to appreciate their unique perspectives" (p. 584).

Their sample consisted of 400 students, ages 6 to 13 years old, across a range of mathematics levels. Although the authors investigated a total of 12 schools, they used transcribed interviews for this pre-liminary analysis from two of the schools. Young-Loveridge et al.'s (2006) study focused on "students' responses to the question: 'What do you think math is all about?'" (p. 584). The authors examined specifically children's views of mathematics and mathematics learning. Students had different responses to the general question posed in the study. In order to identify the main ideas and themes from the interviews, a content analysis was used. The responses related to mathematical content, processes, its utility, and the enjoyment found in learning mathematics.

Some students perceived mathematics as being more than just numbers. They expressed it can be fun, especially as it relates to geometry. Some students perceived utility in problem solving, in real-life situations such as using it for finances, or just to get "brainier" (p. 586). Some students were able to reflect into the importance of mathematics for every job, and thus as a skill necessary for their future. Other students, in contrast, didn't find it easy to identify the use of mathematics in real life.

Several important findings rose from Young-Loveridge et al.'s (2006) inquiry into students' perspectives. First, many students do mathematics without much opportunity to discuss what mathematics actually is. Second, many children perceived mathematics as being about computation (p. 588). Very few students reflected on mathematics processes such as problem-solving, developing logic and reasoning, and communicating mathematical ideas. This situation possibly reflects the narrow view of mathematics held by people in our society, which in turn affects children's views. Finally, the authors suggested that students' beliefs held about the nature and usefulness of mathematics can help or hinder them in seeing links between school mathematics and everyday practices which in turn might affect their engagement in learning mathematics.

In yet another study, Sullivan et al. (2010) examined how students describe their ideal lesson. The authors were interested in discovering what students say about the characteristics of the lessons they value. They used a survey to gather students' views as a narrative in a free format response. The survey used prompts such as: "think about all the math lessons you have EVER BEEN IN. Now think about the best math lesson you have EVER BEEN IN. Describe what you did in that lesson" (p. 532). To expose the reason behind students' descriptions, the authors further invited students to write a story about the best mathematics class, the lesson features they liked, and what they appreciated their teachers to be doing in their ideal mathematics class. The sample consisted of 940 students grades 5 to 8 who completed surveys, from 96 classes, across 17 schools.

Students' responses were grouped into several categories: challenging, easy, fun/interesting (the highest number), I learned something new (second highest), I am good at this (third), went outside, worked in groups, and made a model. Students' replies were very diverse;

however, two trends were observed – one related to recalling of effective teaching of a topic and another one, of recalling an interesting pedagogy aspect (i.e., playing a game, going outside, or using a real-life example). The authors concluded that students' testimonials were similar to the characteristics that are often used by researchers to delineate the features of effective teaching. In particular the students liked clear explanations, they recalled lessons that used materials that allowed connections with their life experiences, felt the mode of grouping to be important, and many liked to be challenged. There was diversity in the types of lessons that they described indicating that variety is also important. The diversity in students' answers suggests that "there is no commonly agreed ideal lesson, and there are many ways that students experience engaging lessons" (p. 536). Additionally, the responses to the prompt about an ideal lesson seemed dependent on the teacher and his/her pedagogical approach.

Patrick et al. (2007) is yet another study that delves into investigating students' views. The data was collected as a part of a school's project exploring motivation in learning mathematics. The participants were 602 students in 5th grade from 31 classes, in 6 schools (95% of the students were European American). The authors used surveys to capture information about students' perceptions of the social environment, their engagement, and their motivation in learning. The results suggest that the classroom social environment is important to student engagement. The students were more likely to use self-regulatory strategies and engage in tasks when they felt encouragement and emotional support from their teacher and received academic support from their peers. Motivational beliefs were found to mediate the link between educational support and students' engagement. "That is," the authors stated, "it provides support for the premise that perceptions of the social environment affect students' academic and social

beliefs about themselves, which, in turn, affect their behavioral and cognitive engagement in class and then their achievement" (p. 94).

These studies however did not focus on the views of students with disabilities. They unveiled themes, nevertheless, that are common to all children. They also highlighted the importance of listening to the needs and wants of young individuals in order to provide them with the right tools necessary for their own survival and success.

Students with Disabilities' Voice

Kortering et al.'s (2005) study inquired into the voices of students with and without disabilities. They examined what works best to help youth with LD (46) and without (410) succeed in mathematics by inquiring into their perceptions of learning algebra. The purpose of the study was to find insights from the students themselves about the best way to help them succeed, insights that would further inform appropriate intervention models. The research inquired, through a quantitative methodology, into their favorite class in school, what has been the best and most difficult part of algebra class, what can help them become more successful in their work and tests, and what is the most important thing that can help them improve their performance (p. 192). Both students with and without disabilities perceived mathematics as their least favorite class (albeit the LD had a higher percentage). For both groups of students, the primary reasons for identifying mathematics as their least favorite subject were apparent difficulties of the course, lack of access to a kind and caring teacher, and/or lack of interesting material or tasks (p. 201). Both groups of students considered similar accommodations such as additional encouragement from the teacher, more individual or small-group help, time extensions for tests and homework, and reduced classroom distractions. The students' views on the most important action teachers can do to improve their performance was similar as well for both

groups. They placed group or peer activities as having the highest impact on their learning, the second was software programs, and the third candy incentives (p. 201). As compared to their typically developing counterpart, students with disabilities showed a slightly higher preference for getting help in learning and test taking strategies and in the use of software programs to learn algebra. Perhaps a qualitative inquiry would be able to capture and explore in depth the "why" behind preferences and learning differences.

Fullarton and Duquette (2016) examined the experiences of four students with LD in college (identified as LD since elementary school) using a case study design, in-depth interviews, and a cross-case data analysis. Students' age ranged from 21 to 25. Some of the questions included: "What personality traits help you or will help you reach your goals?" and "What have you learned from this experience?" Their testimonials show a pattern of vulnerabilities and assets that helped them be successful despite difficulties. One of the students expressed, "I am a quick learner, independent, and good at problem-solving" and "I take my toolkit of strategies [and accommodations] and determine how to apply them and my strengths to particular problems" (p. 58). His parents appeared to be the most important source of support. Another student attributed her academic success to her mother's support, her friends, and the accommodations she received. The student uttered, "You almost forget you have a disability when you have so much help" (p. 59). Playing a sport while in school helped her as well, with having a social support network and building her self-confidence. The third student revealed that she experienced learning difficulties and felt anxious over the years. She also relied on the support of family and friends and on the help and accommodations received from school. Finally, the last student experienced severe difficulties in reading and mathematics since 2nd grade. Her 11th grade history teacher recognized and commented on her strength in writing essays and

encouraged her to consider a career in social studies. Again, her family was very supportive during her educational journey. The following excerpt is a testimony summarized by Fullarton and Duquette (2016) of the supplementary work needed for a student with disability in order to succeed:

> She feels that her greatest challenge is remembering information because her memory is so poor. To compensate, she reads her notes a week in advance to familiarize herself with the material, then two days before the exam she crams by writing out her notes and memorizing them. Following this procedure, she is able to retain the information until the exam is over. Another coping strategy is to take only four courses during the fall and winter and one course during the summer. (p. 61)

The themes that resulted from the cross-case analysis were related to barriers and facilitators of success. Regarding barriers, all four participants were identified early as students with LD – three had memory difficulties, three showed weaknesses in reading, two had processing delays, and two had difficulties with writing speed. In terms of facilitating factors, all participants received supports from the institutions in which they attended and from their professors. All possessed individual strengths that helped them in school such as self-awareness, self-determination, self-advocacy, discipline, motivation, and determination. All took classes in high school that met the entrance requirements for university. Lastly, the participants refused to be defined by their disability and chose to focus on their assets. Although the study did not focus on the views of students regarding the study of mathematics, it shows nevertheless, their opinions of their experiences as learners with disabilities.

As Grove and Welsh (2010) and Young-Loveridge et al. (2006) recommended more research investigating the perspectives of students about mathematics and learning mathematics

is needed. The opinions of students with disabilities are even less explored. Qualitative studies, as in Fullarton and Duquette's (2016) research, have the potential to reveal important insights into the wants, needs, interests, facilitators and barriers, and learning preferences of students with disabilities.

Relation to the Study

The findings of the literature review show that students with disabilities are underrepresented in mathematics education research and are conceptualized differently than students without disabilities (Lambert & Tan 2016, 2017). They are viewed in general through medical, behavioral, and information processing lenses, with emphasis placed on students' internal problems and on ways to remediate those problems (Gary, 2004, 2011; Goldstein et at., 1994; Leitner, 2014; Loe & Feldman, 2007). This mentality seems to be "strongly ingrained and operated upon in society at large and consequently in schools" (Tan & Kastberg, 2017).

The current study addresses a theoretical and methodological inconsistency apparent in current research, namely a scarcity in studies that use socio-cultural-historical lens and assets-based narratives in studying students with disabilities and a need for more qualitative inquiries to reflect their diversity (Lambert & Tan, 2016, p. 1060). In addition, the current study looked at high school students, an age group documented as less studied in special education articles (Lambert & Tan, 2016).

Little research draws upon the perspectives of historically disadvantaged students and therefore more research is needed that gives students with disabilities a voice (Gutiérrez, 2013). After all, students themselves know what their vulnerabilities and assets are and what supports work best for them (Merriam, 1998). In order to improve mathematics learning for all children

perhaps it is time to listen to what the students themselves have to say, as the beneficiaries of mathematics education.

Theoretical Framework

The purpose of the current study was to gain an understanding of the ways in which students with disabilities experience the process of learning mathematics at the secondary level and how they successfully negotiate those challenges. Although I do not deny the impact of disability on learning and growth, I contend that circumstantial factors can add barriers or on the contrary, can facilitate children' growth. In other words, no child develops in isolation from other individuals and from the surrounding environment. The current study, therefore, adopted Vygotsky's socio-cultural-historical framework (1978) of human learning and development in order to unravel students' perspectives within their life circumstances and not separate from them. Additionally, research suggests (Lambert & Tan, 2016, 2017; Lambert et al., 2018) there is a scarcity in the use a socio-cultural-historical framework in studies that examine students with disabilities.

Vygotsky's theory (1978) can account for the impact of socio-cultural-historical phenomena on children's growth as a transformative process. The word "historical" indicates the constant moving nature of learning and development, as a child's socio-cultural context changes and is changed by their mutual interaction. Vygotsky's framework (1987), therefore, emphasizes the dynamic interdependence of individual and socio-cultural phenomena in the transformative process of students' learning and development (John-Steiner & Mahn, 1996, p. 192).

In addressing the research questions, the current study focused on three main tenets from within Vygotsky's socio-cultural-historical framework (1987). They are: 1) the zone of proximal development; 2) internalization; and 3) the compensatory reorganization of the brain. Those three

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processes occur as mediated by socio-cultural-historical contextual factors. The interdependence of the three main tenets are presented in Figure 2.

Figure 2

Vygotsky's Framework (1978) and Three of Its' Main Tenets that Impact Students' Success in Mathematics
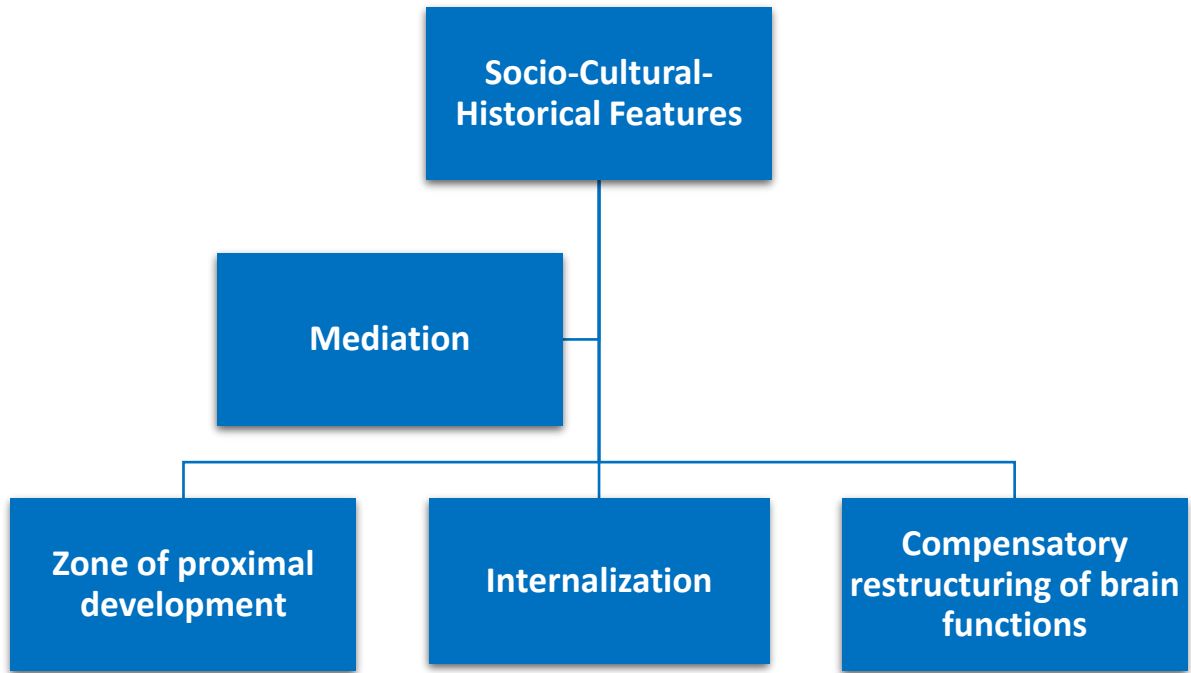
Mediation

Vygotsky (1978) understood the development of human psyche as a correlation between biological and social events, mediated through "psychological tools" specifically, speech, language, and culture. He construed his logic through the parallel between human and animal "conditioned and unconditioned reflexes" (p. 88). As such, it is the social and historical context that brings the human being, when compared to the animal kingdom, an advantageous edge, allowing him/her to make the "qualitative" jump of "doubling experience"– that is, "a human can consciously represent (in mind) the goal of his/her action" (Akhutina, 2003, p. 162). As Vygotsky (1978) expressed,

A primate can learn a great deal through training by using its mechanical and mental

skills, but it cannot be made more intelligent, that is, it cannot be taught to solve a variety

of more advance problems independently. For this reason animals are incapable of

learning in the human sense of the term; human learning presupposes a specific social

nature and a process by which children grow into the intellectual life of those around

them. (p. 88)

Vygotsky (1978) designated the reproduced "mental sign" or "the word", as a specific

human expansion developed through social, cultural, and historical exchanges, responsible for

permitting individuals to pursue goal-oriented actions. Through language, human reflexes

become reversible and the consciousness is born as a byproduct of "social interaction, placed

inwards" (p. 162). "The world" as a "sign," therefore, developed through social experiences,

impacts the formation of the human mind. As Vygotsky states, "the use of signs leads humans to

a specific structure of behavior that breaks away from biological development and creates new

forms of culturally-based psychological process" (p. 40).

Contrary to Piaget's (1950) concept of internally situated readiness in regard to the

mental development in children as a way to construct knowledge through their actions, Vygotsky

(1978) places emphasis on the social nature of development as mediated by cultural artifacts

(Cole & Wertsch, 1996). Our environment is "suffused with the achievements of prior

generations" (p. 251); it includes our cultural values and beliefs, customs, and language.

Vygotsky (1978), therefore, sees development as a complex interactive process, influenced by

three factors. The active individual through the practice of speaking and thinking represents one.

The second is the active environment that impinges upon his/her actions and reactions. Finally,

the third factor involves "the process of co-construction – the accumulated products of prior

generations, culture" – as embodied in various systems for counting, mnemonic techniques, symbol systems, works of art, writings, schemas, maps etc. (p. 251). In other words, the culture in which the individual is immersed impacts his/her development of higher psychological functions in fundamental ways for the simple reason that the artifacts people interact with, are themselves culturally, socially, and historically situated. "In a sense, then," Cole and Wertsch (1996) affirm, "there is no tool that is adequate to all tasks, and there is no universally appropriate form of cultural mediation" (p. 252).

The view of culture as a "mediated tool" implies that the development of the mind and the culture a person is exposed to, are interrelated. The mental action, therefore, appears inseparably linked to the context in which it arises into a single "bio-social-cultural" unit. As Cole and Wertsch (1996) debate, "the higher psychological functions are transactions that include the biological individual, the cultural mediational artifacts, and the culturally structured social and natural environment of which persons are a part" (p. 253). Additionally, all those transactions occur inside the "historical" development of each individual (John-Steiner & Mahn, 1996). In other words, "mediated action" designates the interrelationship between the human physical and mental engagement with the social, cultural, and historical setting in which it takes place (Wertsch, 1994).

Indeed, Vygotsky's stance (1978) is that the "history" of a child's behavior stems from the interweaving of two qualitatively different lines of development, "differing by origin," specifically "the elementary processes, which are of biological origin on one hand, and the higher psychological functions, of sociocultural origin, on the other" (p. 46). Vygotsky (1978) sought to explain human behavior by identifying the brain mechanisms used in each activity, explaining the developmental history in order to ascertain the connection between its parts, and

specifying the societal context in which the behavior developed (Wertsch, 1994). Kozulin (2004) asserts,

> In Vygotsky's model education does not coincide with development but is constructed in such a way as to develop those psychological functions that will be needed for the next educational step. Instead of dichotomy of cognitive functions and curricular content, Vygotsky proposed that such external forms of activity, as reading, writing and numerical operations should be considered on equal footing with other higher cognitive functions. Moreover, curricular content in mathematics, history or biology appears in the Vygotskian model in a conceptual form, i.e., as aspects of the socioculturally-based development of children's concepts. In this way the opposition between cognition and knowledge is resolved by knowledge appearing as a process of concept formation that shapes the students' cognition rather than being understood as information to be processed by the students' preexistent cognitive skills. (p. 4)

Zone of Proximal Development

In order to account for the interdependence of the social context and the participatory action necessary for learning, Vygotsky (1978) developed the concept of zone of proximal development (ZPD). Vygotsky's understanding of the concept was as "the distance between the level of actual development and the more advanced level of potential development that comes into existence in the interaction between more and less capable participants" (Cole & Wertsch, 1996, p. 254). The ZPD therefore allows less capable students to function at their potential level of understanding through the use of "words and other artifacts" in intermental interchanges (i.e., with the aid of another, more competent peer, mentor, teacher).

Vygotsky (1978) introduced the idea of the ZPD as a stance against the inadequacy of psychological testing which measures the current ability and not the potential one. To him, the level of current development represents a measure of what the person has mastered in the past and does not accurately describe true development, namely what a child can achieve with assistance in the future. Vygotsky (1978) asserted,

> The zone of proximal development defines those functions that have not matured yet but are in the process of maturation, functions that will mature tomorrow but are currently in an embryonic state. These functions could be termed the "buds" or "flowers" of development rather than the "fruits" of development. The actual development level characterizes mental development retrospectively, while the zone of proximal development characterizes mental development prospectively. (p. 86)

The ZPD stands in contrast to the way of viewing higher psychological functions as developed from lower ones in which a "deficit" that occurs at a lower level, will re-emerge at the higher level as well. Instead, Vygotsky (1978) sees the lower and higher functions developing in interconnections, each with a specific development of the conscious system (Akhutina, 2003, p. 175). "Between the initial level (elementary behavior)," Vygotsky (1978) states, "and the higher levels (mediated behavior) many transitional psychological systems occur" (p. 46). Furthermore, the human psychological functioning is not "determined by a fixed formula;" the relationship between thinking and speech is flexible and dynamic. Vygotsky does not deny the existence of a lower limit threshold in a child's development at a certain moment, but in his view he/she does not need to await maturation to occur in order to move to the next stage. "The teacher must orient his work," Vygotsky (1934) asserts, "not on yesterday's development in the child but on tomorrow's" (p. 211).

In conclusion, the social-cultural-historical forces function in the learning environment as a backdrop on, within, and through which children can awaken their unique intellectual processes compensatory for any vulnerability. They can use those processes as steppingstones to move safely beyond what they know and are at any given moment to what they can be, to what they can think and create, and to what they can achieve in the near and distant future. Vygotsky (1978) describes this process as follows,

> The zone of proximal development furnishes psychologists and educators with a tool through which the internal course of development can be understood. By using this method we can take account of not only the cycles and maturation processes that have already been completed but also those processes that are currently in a state of formation, that are just beginning to mature and develop. Thus, the zone of proximal development permits us to delineate the child's immediate future and his dynamic developmental state, allowing not only for what already has been achieved developmentally but also for what is in the course of maturing. (p. 87)

Internalization

The higher psychological processes function, in Vygotsky's view (1978), as a dynamic interplay of three stages. The first one embodies an interpsychological stage, in which the individual observes a behavior in others. At this stage, "an operation that initially represents an external activity is reconstructed and begins to occur internally" (p. 56). The second one represents an extrapsychological stage, in which an individual talks to himself/herself about the steps of a behavior (i.e., the reversible reflex). Finally, an intrapsychological stage occurs, in which the behavior is internalized and as such, it can be re-enacted at a later time in the absence of a physical, concrete stimulus.

This process of transformation of an interpersonal process into an intrapersonal one is the result of a prolonged development and "applies equally to voluntary attention, to logical memory, and to the formation of concepts" (p. 57). Both, the intermental and intramental processes take place as mediated through culture, more precisely by the semiotic representation of cultural signs and symbols as embedded within each culture (see also Cole & Wertsch, 1996). As such, Vygotsky (1978) states,

> We have found that sign operations appear as a result of a complex and prolonged process subject to all the basic laws of psychological evolution. This means that sign-using activity in children is neither simply invented nor passed down by adults; rather it arises from something that is originally not a sign operation and becomes one only after a series of qualitative transformations. Each of these transformations provides the condition for the next stage and is itself conditioned by the preceding one; transformations are linked like stages of a single process, and are historical in nature. In this respect, the higher psychological functions are no exception to the general rule that applies to elementary processes; they, too, are subject to the fundamental law of development which knows no exceptions, and appear in the general course of the child's psychological development as the outcome of the same dialectical process, not as something introduced from without or from within. (p. 46)

Vygotsky (1978) therefore, recognizes internalization – a distinguishing feature of human psychology (p. 57) – as the inner reconstruction of social-cultural-historical external manifestations. In other words, a child internalizes the action he/she sees in others. How the child displays the internalized understanding of an action is in turn confirmed by others as successful or unsuccessful. On one hand the child internalizes socio-cultural-historical features from the

context of his/her life and on the other, his/her manifestation of an internalized feature is assigned a connotation in accordance to socio-cultural-historical beliefs. The socio-cultural-historical impact on a child's development therefore has a double impact, one at its input, meaning what children learn from others is socio-cultural-historical determined; and one at its output, meaning how others respond to children' actions is socio-cultural-historical determined as well.

Compensatory Restructuring of Higher Mental Functions

Vygotsky (1978) involved his colleague Luria (as cited in Akhutina, 2003) in the study of "defectology." Their initial focus was on the investigation of speech impairments (aphasia) and of motor deficiencies exhibited in Parkinson disorder as well as in other clinical syndromes. In particular, studies in aphaisa confirmed Vygotsky's assumption that "speech plays an essential role in the organization of higher psychological functions" (p. 23).

Studies in brain impairments allowed Vygotsky and Luria to make considerable strides in understanding the psychology mechanisms of human behavior. As a result of his and Luria's studies on brain injuries, Vygotsky (1978) was able to formulate "one of the principles of modern psychology – the principle of the system structure of the higher psychological functions" (p. 165). In addition, the discovery of the localization of centers with different functions in the brain (i.e., right hemisphere and language functions) pioneered the field of neuropsychology further pursued by Luria (Akhutina, 2003; Akhutina & Pylaeva, 2011).

Through those studies in "defectology" Vygotsky (1978) was able to underscore the flexibility of the human brain. He concluded that it is not the structure, the functions, or the lines of the mind's development that changes but the relationships or the links between those mental functions. In his interpretation, those flexible, interfunctional as opposed to intrafunctional

changes, which he defines as a "psychological system", count the most in the emergence of new mental networks or "constellations". To Vygotsky (1978) the mind is not rigidly determined; rather it is capable of forming new systems, therefore opening the door for new possible function combinations. As suggestively presented by Akhutina (2003), Vygotsky's (1978) understanding of the human mind as translated into modern, computer language, would mean the following: "the evolution of animals implies a change in hardware, that is, a material repository of programs; the development of man implies mostly a change in software, a flexible, easily modified system of programs" (p. 167).

In contrast to Piaget's view (1950), in which learning cannot occur but after certain "maturation levels" are reached (i.e., pre-conditions for learning), Vygotsky (1978) sees learning and development as occurring together, interdependently rather than independently. In his assessment, the development precedes learning in the early stages of a child's life; while later on, learning triggers development and the formation of new links and functions (Akhutina, 2003).

In reference to brain lesions as well as disability, Vygotsky (1978) identified the components of higher mental functioning as following: a primary impaired component, a secondary systemic consequence of the original defect, and a tertiary compensatory re-organization of the brain functions. Akhutina and Pylaeva (2011) illustrates Vygotsky's understanding of disability:

> … in the very common disexecutive syndrome of learning disabilities the primary defect is the underdevelopment of programming and control functions (executive functions). The operations such as orientation within a task, planning, switching to other actions, inhibitory control are disturbed as part of this syndrome. All these symptoms are the examples of manifestation of a primary defect. The problems with all gnostic and mnestic

processes that require concentration of attention, checking and reviewing of perceptual hypothesis, active memorization, etc. constitute secondary defects. Furthermore, children with this syndrome can develop compensatory reorganization: positive adaptive and negative disadaptive. Self-commands, self-discussions of the task (i.e., a transition from the intra-psychological level of a voluntary action to the extra-psychological level) are examples of a positive reorganization. Adopting the role of a class clown (to attract attention, to withdraw from the situation of failure and to increase self-appraisal) is an example of a negative compensation. (p. 160)

Although it has a biological origin (i.e., biological vulnerability), the higher psychological functions of children with disabilities ultimately take a positive or negative compensatory trajectory. Intrinsically, disability becomes socially contiguous rather than inherent to an individual. That is why in Vygotsky's view (1978), it is the socio-cultural-historical take on disability as a primary factor that impacts a student's learning, while disability itself becomes a secondary by-product of the socio-cultural-historical context.

Vygotsky's (1978) principle of dynamic organization and localization of functions in compensatory strategies within the brain suggests the localization of the "deficit" lies within society and not the individual. To Vygotsky (1978) children's development is not a continuous and smooth process in which cause-and-effect are easily distinguishable, but rather is comprised of a causal-dynamic interplay of various factors that contribute to the process. Akhutina and Pylaeva (2011) argue that Vygotsky's understanding of the mental functions occur "as result of interactions between individual genetic program, individual anatomic and functional organization of brain structures, individual experience and subject's own activity" (p. 162). If a child is unsuccessful in using his/her assets to prompt a compensatory re-organization of his/her

cognitive functions, then "the lack of adaptation to social norms is perceived as a deviation in the development process" and might be regarded as a disability (p. 165).

Vygotsky (1978) took a positive, forward-looking stance, situating variations from the evolutionary norm in the context of broader human development, emphasizing ability and possibility rather than attempting to amplify the underdeveloped or absent capacity toward the norm. Through his work in "defectology," the author encouraged the inclusion of people with differences into the mainstream society by cultivating the potential of the whole person (Smagorinsky, 2012, p. 11). Vygotsky (1993) argued, "a child whose development is impeded by a defect is not simply a child less developed than his peers but is a child who has developed differently" (p. 30). This suggests that Vygotsky (1993) does not regard development as an evolutionary norm, therefore deviations from that norm do not need to be addressed or treated. In other words, to Vygotsky a child is a work in progress, who can circumvent physical and cognitive areas of differences to develop new capacities for a satisfying and productive life in society (p. 11). Vygotsky's comprehensive, integrated, dynamic, future-oriented perspective on learning and development emphasizes the socio-cultural-historical mediated bearing on nurturing children's mental processes that can foster competence and success.

Theoretical Framework's Relation to the Study

Vygotsky (1934, 1978) switches the theoretical perspective and interpretation of learning and development from conferring a key position to student's internal processes of maturation, to the primacy of socio-cultural-historical situated influences. Vygotsky's theory (1978) has the power to transmute the view on students' learning difficulties from a focus on the analysis of their internal cognitive processes that appear lacking, poor, or undeveloped (i.e., disability "deficit" model), to a focus on the external socio-cultural-historical context that shapes their

cognitive processes in the first place. Furthermore, Vygotsky's framework (1978) emphasizes agency and possibility in children's learning and development through socio-cultural-historical supports – bringing hope for beneficial transformations to all children, regardless of internal or biological initial vulnerabilities.

If, according to Vygotsky's framework (1978), students' circumstances impact their growth as competent and self-aware individuals, the reverse must be true as well. Namely, students' learning experiences cannot be but a reflection of the social, cultural, and historical context internalized by the students in the processes of learning and development. It follows that research can reveal the status quo of our underlying social and cultural reality, accrued throughout our history, by tapping into students' perceptions and meaning making of their learning experiences. The current study addresses, therefore, the perceived challenges students with disabilities in learning complex mathematics and how they manage to navigate successfully within the boundaries of their specific socio-cultural-historical context.

Methodological Framework

The current inquiry sought to gain an understand of the challenges that secondary students with disabilities experience in the process of learning complex mathematics and how they successfully navigate those challenges. A qualitative research paradigm was considered well-suited to reveal insights into students' perspectives as it relates to mathematics. As Merriam (1998) considers, "research focused on discovery, insight, and understanding from the perspectives of those being studied offers the most significant contributions to the knowledge base and practice of education" (p. 1).

Case study research has several strengths. First, detailed, holistic, and grounded descriptions are invaluable for anticipating similar behaviors in the field. Second, the case (or

cases) is situated within the complexity and the boundary of a real-life context which enhances reader's understanding of the case (Merriam, 1998, p. 41). Third, case studies are commonly used in applied fields such as education, with the potential to improve practice as well as to inform further research and policy. Fourth, although case studies "seem a poor basis for generalizations" or better said "grand generalizations," they bring forth refinement to our understanding of a case (or a few cases), revealing patterns that might occur and that represent generalizations in itself, or "petite generalizations" (Stake, 1995, p. 7). In this regard Stake expressed,

> The real business of case study is particularization, not generalization. We take particular case and come to know it well, not primarily as to how it is different from others but what it is, what it does. There is emphasis on uniqueness, and that implies knowledge of others that the case is different from, but the first emphasis is on understanding the case itself. (p. 8)

Through a case study design the current study sought to illustrate a real-life issue or problem within "a contemporary bounded system" over time and to provide an "in-depth understanding of the cases" (Creswell, 2013, p. 100). In order to accomplish this, the study relied on different forms of data collection methods including interviews, visual representations, document reviews, and researcher-generated memos. The analysis of the study involved an in-depth portrayal of each participant from two classes (as bonded systems) and a cross-examination of the results with a description of the themes that emerged. Vygotskian theory (1978) was chosen as a theoretical framework in order to situate students' education and their perspectives on learning within their unique socio-cultural-historical circumstances.

Summary

Chapter two includes relevant articles that support the overarching research question: How do students with disabilities experience the process of learning complex mathematics in an inclusion class at the secondary level? The literature review was organized in 5 main subparts: 1) students' characteristics in studying mathematics; 2) socio-cultural-historical construction of ability and disability; 3) supports in learning mathematics; 4) perceptions of students with disabilities in learning mathematics; and 5) perceptions of mathematics learning of students with disabilities. It was followed by a description of three of Vygotskyan (1987) tenets used as the theoretical framework for the study and by a presentation of the methodology chosen to answer the research questions and sub-questions.

The literature review revealed that students with disabilities have internal vulnerabilities that prohibit them from performing at the same level with peers in mathematics without additional support (Kortering et al., 2005; Montague & van Garderen, 2003). Because they are seen through medical, behavioral, and cognitive processing lenses, and studied quantitatively as a group, the uniqueness of each individual as well as the learning context each is exposed to is often overlooked (Lambert & Tan, 2016, 2017).

Recent investigations show that with support, students with disabilities are able to find assets to compensate for their learning vulnerabilities (Haft et al., 2016; Lambert, 2015, 2017; Yu et al., 2018). In addition, the literature suggests (Gary, 2004, 2011; Goldstein et at., 1994; Leitner, 2014; Loe & Feldman, 2007) that secondary students with disabilities might experience difficulties in learning mathematics due to their vulnerabilities; however, external socio-cultural-historical factors – such as social, cultural, financial, and technological resources – can provide

supports to facilitate their success at a level comparable with typically developing peers (Bargerhuff, 2013; DuPaul et al., 2006).

In order to improve mathematics education, students' experiences and views on mathematics learning are important considerations. Their perspectives are, nonetheless, rarely sought by researchers and practitioners (Groves & Welsh, 2010). As Tan and Kastberg (2017) advise,

> Our role as mathematics educators is partnering with families, students, educators, and community members (NCTM, 2008) to support, create, and advocate by addressing inequities through responsive mathematics education research. To facilitate this work, dis/abilities, as both a collective group and individual experiences, must be explicitly included in mathematics equity research and advocacy alongside other marginalized groups. Importantly, this inclusion must cover the full range of dis/abilities (e.g., autism, intellectual dis/abilities, emotional and behavioral "disorders") not just mathematics learning disabilities. In doing so, we take on the responsibility of mathematics education research involving students with dis/abilities. We do this because we have long claimed that our work is about all students. We do this because we know the value of diversity and different perspectives in truly inclusive mathematics teaching and learning. We do this because we know that we must view every student beyond socially constructed labels and perceived limits. We do this because we are committed to honoring and understanding (p. 34).

This study attempts, therefore, to add to the current literature regarding the learning experiences of students with different disabilities in learning mathematics in order to add to our

understanding of their challenges and supports, and their growth and achievements beyond

socio-cultural-historical "perceived limits" (Tan & Kastberg, 2017).

Chapter Three: Methodology

Chapter three presents a description of the research methodology undertaken for this qualitative case study to answer the overarching question: How do students)with disabilities experience the process of learning complex mathematics in an inclusion class at the secondary level? First, the research design choice for the study is explained, including a justification of the choice. Second, the process of gaining access to the research site, followed by a description of the setting and context, and the process of participant selection is described. Third, the background information of each participant is presented in a linear fashion. Fourth, data collection sources and the procedures that I pursued in conducting the study are discussed. Subsequently, the process of analyzing the data is introduced, followed by ethical considerations I adhered to during the process of carrying out the study and validity measures I implemented in order to ensure the trustworthiness and credibility of the findings. Lastly, my positionality as an insider researcher is disclosed. The chapter ends with a short summary.

Research Design

The level of insight required to gather contextualized information specific to the socio-cultural-historical milieu of students with its impact on their learning cannot be seized through a quantitative approach. A qualitative methodology therefore was better suited to capture descriptions that would yield real-world knowledge about the thoughts of secondary students with disabilities within existent socio-cultural-historical structures. In particular, a case study design can provide the depth and detail needed to unravel students' views and meanings about their learning experiences in their natural environment (Stake, 2010). As Stake (1995) expressed,

> Case study is expected to catch the complexity of a single case. A single leaf, even a
>
> single toothpick, has unique complexities – but rarely will we care enough to submit it to

case study. We study a case when it itself is of very special interest. We look for the detail

of interaction with its contexts. Case study is the study of the particularity and complexity

of a single case, coming to understand its activity within important circumstances. (p. xi)

A case study design therefore was chosen due to the depth of understanding that I strive

to achieve from the perspectives of the participants (Creswell, 2013).

Gaining Access

Secondary students with disabilities were selected from the high school I was employed

as a special education teacher during the spring semester of the school year 2018-2019. In order

to gain access to the research site and participants for my study, I followed a series of formal and

informal steps. First, I completed the Institutional Review Board (IRB) application at the

institution under the auspices of which the current study was undertaken. After the IRB

application was granted, I sent a formal application to conduct research to the school district

research division. The application was approved and signed by the principal of the school prior

to being sent to the district. Once I received confirmation from the district, I conducted a series

of informal meetings and consultations with the principal, the assistant principals, and

department heads over special education and mathematics. I informed them about the study and

sought feedback into their requirements and/or concerns, if any. The mathematics team teachers

of the two classes from which participants were selected were consulted and asked for their

feedback and support.

Following approval from school personnel, I asked the special education department head

to inform students with disabilities from my two Advanced Algebra classes about the nature and

purpose of my research. A neutral individual was sought after to review the content of my study

and encourage students to participate in order to diminish my possible influence over their

decision, given my double role as insider researcher and special education teacher in the classroom. Lastly, each student from two of my classes received consent letters to hand to their parents. Due to their age, participants signed an assent form as well through which they affirmed their agreement to participate.

Prior to commencing data collection, therefore, students were notified in writing and verbally by the same neutral individual about the purpose of my study, its duration, and the measures in place to protect their privacy and confidentiality. At that time, students were informed they can choose to withdraw from the study at any time or decline to answer any question without penalty. I reminded them about this option throughout the entire data collection duration which spread over a period of three months. Rapport had already been established as I had worked directly with them during the fall semester of the same school year. The interviews took place before or after school in a location with which the students were familiar and comfortable. They completed the drawings at their own convenience, either during class time after they finished their work or at home.

Setting and Context

The study took place in a suburban high school of a major metropolitan city situated South-Eastern United States. The school district had approximately 113,000 students with a diverse student population (i.e., 30.3% Black, 37.2% White, 22.4% Hispanic, and 6.0% Asian), enrolled in 67 elementary schools, 25 middle schools, 17 high schools, one charter school, and one special education center. The disability categories with the highest number of students represented in the district was as follows: 1885 students are identified under ASD, 2368 under OHI, and 5606 under LD.

The high school in which the study was conducted had a population of approximately 2800 students and 140 full-time teachers out of which more than 80% are White. The graduation rate of the school year 2018-2019 was 87.9% (higher than 52% of schools in the state); 57.7% of the graduates were college and career ready. The racial breakdown of students was as follows, Black 37.17%, White 33.13%, Hispanic 19.23%, and 4.98% Asian. The demographics of the suburb area in which the high school is located, however, had a higher white population percentage (61.90%) than the one in the school. The poverty level as measured by the number of recipients of free and discounted lunch was 39.5%. The low socio-economic status breakdown was as follows: 19.1% Black, 6.5% White, 11.2% Hispanic, and 1.4% Asian.

At the time of this investigation, the school had 395 students with disabilities. Six-unit classes were small group with a total of 55 students (i.e., for mildly, moderate, and severe intellectually disabled and two for low functioning students on the autism spectrum). As such, 340 students with disabilities were served in an inclusive setting which represent approximately 12.14% of the student population. The total percentage of students with disabilities was 14.1%, which is comparable to the national average of 14% (NCES, 2018). The breakdown on race/ethnicity and disability was as follows: 5.4% Black, 4.3% White, 2.7% Hispanic, and 0.3% Asian. Dividing the total percentage in the school for Black, White, and Hispanic, to the breakdown for disability, yields an underrepresentation of black students in special education. The enrollment breakdown for remedial program was 8% Black, 3.9 White, 5.2% Hispanic, and 1.1% Asian (i.e., a before/after school program that allows students that failed the class with a 65 or above to work on failed tests in order to pass the class with a 70); while the enrollment breakdown for gifted students was 3.8% for Black, 8.9% for White, 1.3% Hispanic, and 0.6% Asian. The school had approximately 112 English Learners (ELs) out of which 95 were active

and of those active, 27 were dual identified as ELs with a disability; and 17 were monitored of which 4 were ELs with a disability.

The school's schedule is divided in four blocks per day, each of 90 minutes. In order to graduate, students need to earn a total of 23 credits of which they are required to pass, in a pre-established sequence, four academic classes in mathematics, science, and language arts and three in social studies. Each mathematics class is offered at four levels of difficulty. The Advanced Placement classes are situated at the high end, for the top achieving students, followed by Honor, and on-level classes. At the lower end is situated the mathematics with support class offered to low achieving and/or unmotivated students and to students with disabilities; those classes continue for a full educational year.

There are a few major differences between the on-level, honors, and advanced classes and the mathematics class with support. First, the later takes a full year as opposed to one semester for the other three options. Second, the content is delivered at a slow pace and is offered at an inferior depth and breadth of skills and knowledge. Third, procedural knowledge is emphasized with very little conceptual weight. Fourth, the grades are divided in two separate rubrics; one grade counts as a mathematics credit and the other grade, as an elective, taking the place of a true elective choice. The mathematics part of the class consists of scores from quizzes, tests, and major projects (if any) as summative assessments while the support part contains grades from classwork and, depending on the teacher, from warm-ups and tickets out the door as formative assessments.

Four students volunteered for the study from two different Advanced Algebra with support classes. One student, Armando, took mathematics during my first block class. The general education teacher was a middle-age and coach white American male. The demographics

of the classroom was as follows: 5 girls (2 had disabilities) and 15 boys (7 had disabilities) out of a total of 20 students; 10 students were Black (4 had disabilities), 4 were White (2 had disabilities), and 6 were Hispanic (3 had disabilities, 1 was EL, and 1 was EL and LD). From the students with disabilities 7 were identified as LD, 1 as OHI, and 1 was LD and OHI.

The remaining three participants, Benjamin, Caleb, and Daniel were peers in my second block Advanced Algebra class. The general education teacher was a middle-age Black woman. The composition of the classroom was as follows: 6 girls (1 had disabilities) and 18 boys (8 had disabilities) out of a total of 24 students; 10 students were Black (4 had disabilities), 9 White (5 had disabilities), and 5 Hispanic (1 had disabilities). Among the students with disabilities 5 were identified as LD, 4 as ASD, and 1 as OHI. For both classes, I functioned in a double role as the special education team teacher and the insider researcher. I identify myself as a middle-age, minority white naturalized woman from Eastern-Europe, belonging to a Latin culture.

Participant Selection

Any student enrolled in two inclusive, junior-level mathematics classes in which I functioned as the special education teacher and were identified as having a disability (i.e., had an IEP in place) were potential candidates for the study. Although purposive sampling is recommended for qualitative inquiries (Creswell, 2013; Palys, 2008; Patton, 2002), a self-selected or convenience sample was used based on the assumption that the views of any student with disability is equally significant and relevant to the subject under investigation regardless of their particular characteristics. In other words, each student can provide unique and rich information of central importance to the purpose of the inquiry (Etikan et al., 2016). In addition, a convenience sample was a better choice for the current study in order to restrict the possible

impact of my own preferences and anticipated results as an insider researcher and students'
teacher in the classroom.

Out of a total of 20 students with disabilities present in my two Advanced Algebra
inclusion classes, four brought a signed consent and assent form and therefore were able to
participate in the study. Creswell (2013) recommends four to five participants as being suitable
for conducting a case study. He stated, "this number should provide ample opportunity to
identify themes of the cases as well as conduct cross-case theme analysis" (p. 157). Patton
(2002) indicated that the validity, meaningfulness, and insights from qualitative inquiries depend
on the information depth and detail regarding the investigated cases and the analytical aptitude of
the researcher and less so on the sample size (p. 245).

Participant Portraits

The participants were four self-selected 11th grade students, with a disclosed disability,
from two Advanced Algebra inclusion classes in which I served as their special education
teacher. In order to protect their privacy and confidentiality, each student was assigned a
pseudonym following consecutive letters of the alphabet. The pseudonyms are respectively:
Armando, Benjamin, Caleb, and Daniel.

Although a convenience sample was used with its inherent biases (e.g., lack of
generalizability of results), the students that volunteered had very different profiles akin to
maximum variation sampling (Patton, 2002). All four were male, 16-year-old high school
students with different disabilities (i.e., LD, ASD, and ADHD), different levels of achievement,
and from different racial, ethnic, and cultural backgrounds (see Table 2 and Table 7 from
Appendix Q for students' data). The high variation in characteristics permitted 1) portraying
"detailed descriptions of each case, which are useful for documenting uniqueness", and 2)

finding "important shared patterns that cut across cases and derive their significance from having emerged out of heterogeneity" (Patton, 2002, p. 235).

The questions addressed through biographical interviews and information collected from documents is included in participant portraits. The data is presented independently for each student, in a linear fashion, to ensure a comprehensive description of each case and a correspondence of evidence across cases. Each student as a case, is presented independently with information regarding their background. The data is presented using the following subheadings: a) family background; b) exceptionality background; and c) academic background and elective choices.

Armando

Armando was an English Learner student (EL) at the monitoring level. He received specially designed instruction under the IDEA category of learning disability (LD).

Family Background. Armando came to the U.S. from Mexico with his identical twin and parents when he was 3 years of age. His parents did not finish their high school studies and were not married. After they separated, Armando and his twin brother moved with their father and stepmother to a different state. His biological mother worked with his stepfather in construction, and his father worked in landscaping. He had one "little brother" from his father's side and two sisters and another "little brother" from his mother's. At home he spoke Spanish.

Exceptionality Background. Armando received services in English as a Second Language Program (ESOL) and Early Intervention in elementary school in the U.S. He was provided a special education evaluation at the request of his father when he was in 5th grade (at 10 years of age) due to concerns regarding his reading level and difficulties with focusing. He was placed on Tier 2 of the Response to Intervention (RTI) process due to reported weakness in

reading and difficulties with mathematics concepts and problem solving. The teachers noted that Armando worked hard in class and at home in terms of completing assigned work. Although he could decode many words, he had difficulty understanding them and struggled with finding information within reading passages. His teachers concluded that he was not responding adequately to the implemented classroom remediation strategies (i.e., reading questions before text, use of the UNRAAVEL procedure, and graphic organizers) and thus, referred him for testing.

In order to determine Armando's proficiency in English and Spanish he was administered the same intellectual ability test in both languages. His scores indicated that he was slightly more proficient in Spanish than in English, and as a result supplemental testing was conducted in Spanish. Due to Armando's weakness in verbal reasoning, the examiner considered his nonverbal score, which was below average level, as a representation of his overall intellectual skills. His academic achievement was consistent with his ability level. He displayed a significant strength in pseudoword decoding and in mathematics calculation and a weakness in mathematics reasoning. Armando's scores in word reading, reading fluency, and essay composition were within the average range and his reading comprehension was in the below average range.

Armando showed processing weaknesses in verbal reasoning skills, long-term retrieval, processing speed, and cognitive fluency. Armando's weaker verbal reasoning skills may make it difficult for him to understand what mathematics word problems were asking him to figure out. Weaknesses in long-term retrieval indicated that Armando may have difficulty retaining steps in mathematics problems from one day to the next. His processing speed difficulty suggested that Armando could take longer than others to complete tasks and may fall behind in work completion. Finally, his cognitive fluency weakness may cause Armando to take longer than

expected to recall previously learned information needed to solve problems. These processing difficulties helped explain Armando's struggles in mathematics reasoning. In conclusion, the examiner recommended that Armando be considered for eligibility in the area of Specific Learning Disability. Armando continued to be monitored as English Learner (EL) throughout high school. His disability could have impeded his ability to pass the ACCESS language test.

If an examination of Armando's processing weaknesses provided insights into potential contributing factors to lower-than-expected academic performance, his strengths provided insights into how he may learn best. His relative strengths (the scores are in the average range) were in visual-spatial thinking, memory of words, auditory working memory, and visual-motor integration. In terms of socio-emotional functioning, his father indicated that Armando had average behavior for a child his age in all areas. His teacher, however, reported that Armando had trouble keeping up in class, had reading and mathematics problems, and earned failing school grades. She further assessed Armando as being at risk for problems in the area of functional communications. She noted that he was unable to provide his home address and telephone number and was sometimes clear when telling about personal experiences.

As of his last Individualized Educational Program (IEP), Armando received support in all his academic classes, co-teaching model for language arts and mathematics, and collaborative support for science and social studies (i.e., the student received support for 45 minutes out of 90 minutes block). In the IEP, his case manager noted that his strengths were in the following areas: mathematics calculations, working memory, short term memory, visual motor integration, visual spatial thinking, and cognitive efficiency. Those strengths, however, were comparable to his ability level, which was ranked as below average. His weaknesses were indicated in the following areas: mathematical reasoning, reading comprehension, verbal reasoning, long term

memory retrieval, processing speed, and cognitive fluency. The goals monitored within the general education setting by the special education teachers were agreed upon in order to ensure Armando's progress. It addressed all academic areas: reading comprehension, grammar, writing, mathematics, and school behavior (i.e., Armando will not blurt out words or phrases during instruction or practice).

Academic Background and Elective Choice. Armando was 16 years of age, enrolled in 11th grade. He accumulated 19 credits of 19 attempted in high school and had a grade point average situated in the middle range (GPA; measured on a scale of 0 to 4). His grades in mathematics (i.e., the mathematics credit part of the yearlong "mathematics with support class" offered to students with mathematics difficulties; it includes only summative assessment grades and counts as a mathematics credit) and in mathematics support (i.e., the elective credit part of the yearlong "mathematics with support class"; it include formative assessment grades) were both C. He had failing grades for state-mandated standardized tests for both 9th grade Algebra and 10th grade Geometry. His grade in the Advanced Algebra class was a high B and in the support/elective part of the Advanced Algebra class, was a B. He passed the state-mandated standardized testing for 9th grade Literature with a low C and failed the ones for Biology and U.S. history (the grades are listed in Table 7 from Appendix R). Armando took Spanish II class and was enrolled in Honors Spanish III at the time of the study. As electives he chose Introduction to Orchestra and Advanced Orchestra. As career tech interests he pursued Introduction to Drafting Design, and Audio and Video Technology and Film (Video-production).

Benjamin

Benjamin was a student with a dual exceptionality. He was identified as a gifted student with Autism. He was served in special education under the learning disability (LD) eligibility category.

Family background. Benjamin was a white American student, single child, living with both parents. His mother held a master's degree in Information Technology and worked for a well-known security and aerospace corporation, leader in scientific discoveries and manufacturing. His father held an engineering degree and worked in management for a small, Dutch company.

Exceptionality Background. Benjamin was referred for a developmental evaluation by the IEP committee when he was 3 years old due to concerns in communication, attention, and social skills. He was already receiving speech and language services at the time which continued until he was 10 (5th grade). Reports from the preschool teacher and mother portrayed a 3 year old Benjamin (enrolled in a 2 year old classroom) as having difficulties with communication skills such as asking appropriately for help and responding to questions; fine motor skills such as cutting with scissor or using a writing utensil correctly; adaptive skills such as staying with the group during structured activities, completing an independent task, and manifesting age-appropriate toileting skills; and social/behavioral skills such as playing well and initiating interactions with peers, trying new things, complying with teachers' requests, or displaying self-control (no tantrums or rarely cried or got upset).

The teacher noted in the preschool questionnaire: "Yes, Benjamin does disrupt the classroom environment, doesn't participate in circle activities, art, outdoor play or dramatic play. He doesn't respond to redirection or positive reinforcement." Regarding his communication

skills, his preschool teacher noted that "Benjamin will cover his ears and just screams until he can be calmed down." His cognitive and academic readiness skills, however, were advanced. The teacher stated that he knew letters, numbers and rhymes, but didn't do them with the class.

Benjamin received 2 scales and 1 inventory (i.e., Mullen Scales of Early Learning, Vineland Adaptive Behavior Scales, and Developmental Activities Screening Inventory). Data from parent interview, preschool teacher questionnaire, and play observation was also collected. After the examination of the data, the examiner noted the following areas of strengths and weaknesses: Benjamin resisted participating in group activities, was not toilet trained and could not dress himself, presented adequate fine and gross motor skills, his cognitive skills were hard to determine due to his weak communication and hardships in attending to nonpreferred activities, and difficulties with expressing his wants, needs, and feelings verbally and nonverbally.

Benjamin was identified as displaying significant developmental delay and continued with the same label up to 5 years of age, when he started to be served under the eligibility of Autism (served as LD), as his primary area of disability. He was referred at 6 for the gifted program but was found ineligible. The initial eligibility as a gifted student occurred during 8th grade and continued automatically thereafter.

The district conducted a full psycho-educational evaluation when Benjamin was 8-year-old (3rd grade). The results were consistent with an eligibility in the area of Autism Spectrum Disorder. His cognitive functioning was in the below average range; however, his verbal skills were thought to be his best indicator of cognitive ability and was in the average range. His academic achievement scores were consistent with his ability level with reading and mathematics scores being average (above 100). Significant weaknesses were found in the area of sentence-

writing when the demands of the activity were very open-ended. Benjamin demonstrated relative processing weakness in the area of auditory short-term memory. His skills in visual-motor integration, cognitive functioning, long-term retrieval, processing speed, and working memory were consistent with his ability level (average range).

Behaviorally, Benjamin was considered to display many characteristics of a student with Autism. He showed difficulties with social behavior, changes in routine, taking turns in group work, had a very concrete way of interpreting information, and had a lot of sensory needs since birth. Behavioral rating scales indicated concerns with atypical behaviors, withdrawal, and social skills. His performance on the Asperger Syndrome rating scale indicated symptoms correspondent with a "likely" probability of an Asperger Syndrome. Both his teacher at the time and his mother indicated that Benjamin talks excessively about favorite topics, interprets conversations literally, does not respect personal space, has few friends in spite of a desire to have them, frequently becomes anxious when unscheduled events occur, functions best when engaged in familiar and repeated tasks, lacks organizational skills, and appears clumsy and uncoordinated.

By 11th grade, Benjamin received special education services in the co-taught model only as it relates to the field of mathematics. Before high school he received support in language arts as well due to reported weaknesses in writing. In his last IEP, strengths were noted in the areas of written expression, reading, reading comprehension, oral expression, listening expression, work habits and social skills, and weaknesses in short-term memory and in solving equations and formulas accurately. Benjamin's disability was assumed to impact his involvement and progress in the general education curriculum without accommodations, due to his processing weaknesses in the area of auditory short-term memory.

Academic Background and Electives Choice. Benjamin was 16 years old and in his 11th grade. He passed 19 credits out of 19 attempted out of a total of 23 needed for graduation and had a GPA very close to the high end (on a scale from 0 to 4). His past grades for the mathematics and support/elective mathematics classes were all As and high As. His standardized test scores for Algebra and Geometry were Bs. His current grades for Advanced Algebra and for the support/elective part of the class were in the middle B range. His state mandated standardized scores were middle B for 9th Grade Literature, and As for American Literature and Biology. He passed Chemistry with an A; had a high B in Genetics and an A in AP U.S. History (passing the AP exam gives a student college credit). He took four electives in Band, and he tried three different career paths: Introduction to Digital Technology, Introduction to Law and Public Safety, and Introduction to Drafting Design.

Caleb

Caleb was a student with Autism. He was receiving specially designed instruction under the IDEA category of learning disability (LD).

Family Background. Caleb was a black student and first generation American. He was born in the country, but both parents immigrated to the U.S. in their youth and become naturalized citizens. His father finished his high school in Kenya and had come to U.S. to get a "full education," as Caleb specified. His father attended a local university and received a bachelor's degree in systems technology. His father brought his younger brother to the U.S. from Kenya. After finishing his higher education, he become a professor at the local university in the information technology department.

His mother came to the U.S. from Kenya on her own, brought in turn by her sister, "so she can get an education". Caleb affirmed,

Yeah, my aunt, the oldest in the family, of the siblings… of the siblings on my mom's side. She lives in Indiana. She is still working hard. She is a nurse. Most of my family, most of my family on my mom's side are into the medical field of some form. (Caleb, personal communication, April 26, 2019)

His mother continued her studies at night at the same local university as his father, while working during the day "specifically the cardi… cardiological," Caleb indicated, "so, she works with patients that have heart problems." Caleb mentioned that "she got her bachelor's not too long ago, like last year actually. Aaa… we went to the graduation last year" (Caleb, personal communication, April 26, 2019). Caleb's mother and father met and got married in the U.S. He had two younger brothers, each born four years apart. At home the family spoke English and Swahili.

Exceptionality Background. Caleb's parents requested an evaluation be done on their child due to concerns related to inability to focus or sit still for long in his preschool setting and delayed language skills. Referral information from his pre-school teachers indicated that Caleb displayed aggressive behaviors toward peers and adults, did not comply with directions, and exhibited poor impulse control (i.e., runs away from teachers, throws himself into furniture, hits, kicks, spits, and head butts). He was identified as being Significantly Developmentally Delayed (SDD) at 4 years old and recommended for related support services in speech and language which continued till 5th grade. Despite socio-behavioral concerns, Caleb knew all the letters of the alphabet and their sounds. If given classroom jobs, he completed them with pride albeit at times it took him a long time to complete academic tasks due to inattentiveness.

Later the same school year, a reevaluation was conducted by his IEP committee to consider categorial eligibility. During kindergarten, his levels of intellectual functioning and style

of problem solving placed him within the low (borderline) range of intellect. The evaluator, however, noted that the test should be considered as a minimal estimate of Caleb's cognitive abilities due to his high levels of distractibility and a limited attention span for adult directed tasks. Academic readiness was found to be within the average range in acquired knowledge (recognition of letters, numbers, colors, and basic counting skills). Verbal-conceptual abilities and visual-skills were found to be significantly below average reflecting possible processing deficits or behaviors that interfered with his performance.

Results from a behavior assessment instrument completed by his kindergarten teacher and the parent were not consistent. The teacher indicated clinically significant ranges for externalizing problems and overall behavioral symptoms. She rated him as having clinically significant indicators in the areas of hyperactivity, aggression, and depression. He was rated in the normal range in adaptive skills. The following items were noted as deserving attention: bullied others, hit other children, threatened to hurt others, fell, ate things that were not food, and was easily annoyed by others. Within the classroom setting, the teacher noted that Caleb exhibited verbal and physical aggression toward teachers and peers, become easily upset, cried frequently, had a limited attention span, was easily distracted, sometimes appeared confused and out of touch with reality, exhibited an elevated level of activity, and had poor self-control. His mother, however, reported no areas of concern. He often fiddled with things at meals and sometimes threw tantrums.

His inappropriate behavior patterns were deemed to interfere with his classroom functioning, interpersonal relationships, and social/emotional development. His aggressive behaviors toward others and his poor impulse control were believed to make it difficult for him to progress in a general education classroom setting without a significant amount of external

structure. He exhibited a number of behavioral characteristics that were consistent with a diagnosis of Attention Deficit Hyperactivity Disorder (i.e., he was overly active, got easily distracted, displayed poor impulse control, and exhibited a limited attention span). A behavioral plan was recommended to address his difficulties. A medical evaluation was available in the student's records containing a diagnosis of ADHD (from 10 years old) that needed ongoing intervention. He had been prescribed 70 mg of Vyvanse to manage his symptoms.

Although Caleb had a medical diagnosis of ADHD, his eligibility category was changed when he was 5 years old from Significant Development Delay to Emotional and Behavioral Disorder (EBD), eligibility that continued until he was in 6th grade. In 6th grade, he was referred for reevaluation by his IEP committee due to concerns related to difficulties focusing on instruction and completing his assignments as well as concerns related to exhibited traits that are associated to Autism Spectrum Disorder. His observed difficulties with focusing and a lack of social interaction with peers, however, was noted to be due to Caleb's habit of reading books at his desk. This pattern could indicate a lack of external challenge rather than internal deficiency. A second psychological evaluation was conducted. As a result, a very different portrait of the child emerged.

His intellectual functioning was measured at average range (above 100 on all measurements with verbal comprehension being the highest and working memory the lowest). His scores on academic achievement were even higher, at above 70th percentile for broad reading and reading fluency. The measures of mathematics calculation and applied problems were high as well showing results in the average and high average range; mathematics fluency was his relative weakness (average score). A weakness was found in memory functioning assessment; his score was in the low range of functioning. Two special education teachers

completed the social/emotional/behavioral functioning rating scale. His 5th grade teacher rated Caleb's behavior in the clinically significant range in the areas of attention problems and atypicality, and at risk-range for hyperactivity, learning problems, withdrawal, and study skills. His 6th grade teacher rated his behavior as at risk only in the area of withdrawal (i.e., behaviors associated with constructs such as shyness, isolation and rejection, social reticence, passivity, and peer neglect). His mother's assessment of Caleb's social/emotional/behavioral functioning was in the typical range.

An Autism Spectrum Rating Scale was used to quantify observations that are associated with the Autism Spectrum Disorder. His 5th grade special education teacher indicated that Caleb demonstrated symptoms related to Autism, the most significant symptoms were atypical language, stereotypical behaviors, and behavioral rigidity. However, his 6th grade special education teacher did not indicate unusual behaviors or problems with attention and impulse control. She noted that he related well with adults, used language appropriately, did not engage in stereotypical behaviors, and tolerated changes in routine well. She indicated difficulties using appropriate verbal and non-verbal communication and rarely seeking the company of other children. On a task given to check his ability to recognize emotions from pictures of children's faces, Caleb obtained a score within normal limits. On a general adaptive scale, his overall adaptive behavior was described as below average when rated by his 5th grade teacher and average, when rated by his mother.

Regarding processing visual information, Caleb tended to focus on details at the exclusion of the whole. In mundane tasks, the more cognitive demands were placed on him, the more effectively he guided his attention. The evaluator concluded that when Caleb was provided with factors to focus his attention on, his ability to ignore irrelevant input grew stronger. When

provided with the procedural steps to solve a problem, Caleb persisted with that approach to completion. Although Caleb was effective in problem solving, he had difficulties coming up with alternative approaches when and if he could not find a solution with the initial approach.

A review of Autism rating scale indicated that Caleb displayed some behavioral characteristics specific to children diagnosed with Autism. Observations and ratings from his teachers at the time indicated that Caleb strived with communication skills as well as social skills. His mother did not observe those behaviors at home. The evaluator noted that Caleb persevered on preferred topics of discussion (i.e., video games). During two separate observations, he was observed reading a book as opposed to engage with peers during unstructured time.

In his last IEP, it was noted that Caleb's intellectual functioning and academic achievement in reading comprehension, mathematics calculation, and mathematics reasoning were strengths for Caleb (within average to high average range). Another strength was found in written expression, however, his writing lacked correct punctuation and details. His weaknesses were indicated in the area of attention and focus. He preferred to work alone and on tasks that would provide a challenge.

Academic Background and Electives Choice. Caleb was 16 years old, enrolled in 11th grade. He earned 20 credits while he attempted 19, which indicates that he had earned one high school credit while he was in middle school. His GPA was within high average range. He had at the time a low B in the Advanced Algebra class and a high B for the support/elective part. He passed all mandated standardized tests with grades from low Cs in 9th grade Algebra and American Literature and Bs in Geometry, 9th grade Literature, Biology, and U.S. History.

As electives, Caleb took Intermediate Band his first year of high school after which he continued with Men Chorus courses. During 11th grade he was enrolled into Mastery Men's Chorus II, his 5th class in the same area.

Daniel

Daniel was a student identified as having Attention Deficit Hyperactive Disorder. He was receiving specially designed instruction under the IDEA category of Other Health Impairment.

Family background. Daniel was white American with about a quarter Cherokee Indian lineage from both parents (one grandparent from both sides was full Native Indian). Daniel mentioned on many occasions he identified with his Indian roots. His parents were divorced and each had re-married. Daniel and his biological brother lived in a "separate household arrangement;" one day both went to one parent's house and the next day, to the other. Daniel expressed contentment with this living arrangement although it involved a lot of travelling between houses because he wanted to see both his parents. He had a half-sister from his father and 3 stepbrothers from his stepfather. His mother had a bachelor's degree and worked in accounting, and his father had a high school education and did electrical work. He received presents from both families and vacationed often with either his father's or mother's family.

Exceptionality background. Daniel was diagnosed by a physician, at 10 years of age, with Attention Hyperactive Deficit Disorder with an anticipated impact on his educational performance due to increased impulsiveness and decreased attentivity. He was prescribed 15 grams of Adderall to take in the morning. It helped him get "through most of the day," however, its effect diminished by lunch time, and Daniel had to take an additional small amount (Daniel, personal communication, April 10, 2019).

He was referred to special education services due to academic and attention concerns after Response to Intervention (RTI) monitoring process yielded limited improvement. Specific interventions implemented through the RTI included: prompts to remain on task, extended time to make corrections on assignments, small group oral reading instruction, and the use of textbooks to aid comprehension. He was evaluated when he was 11 years old (in 5th grade), in order to establish special education eligibility.

Current levels of intellectual functioning placed him in the low average range of intellectual ability, with a relative high score in perceptual reasoning and verbal comprehension (high 90s), and a low average score on working memory and in processing speed (in the 80s). Daniel's scores on individual subtests demonstrated low average to average abilities in all areas assessed with a relative weakness in short-term memory and a relative strength in visual analysis and synthesis. His scores on a test of educational achievement revealed slightly higher than average scores on mathematics concepts and computation, average in letter and word recognition and mathematics computation, and below average in written expression.

His score on an oral reading test fell in the below average range indicating a slight weakness in reading fluency. His receptive language was found to be within average limits. His scores on a visual-motor integration test placed him within average range of development. His scores on phonological awareness, phonological memory, and rapid naming were from low average to average range. Daniel scored in the average range for verbal and visual memory as well as for attention/concentrate index. Scores on an instrument designated to assess ADHD revealed concerns at school and at home in the area of inattention. He demonstrated more behaviors associated with ADHD at home than in the school setting.

Daniel was found eligible under the category of Other Health Impairment (OHI) due to concerns regarding completing tasks within a given time frame and below grade level achievement results in reading, math, and language arts. The committee determined that Daniel could not close his observed achievement gap from 5th grade and perform on level with typically developing peers without the help of accommodations and specialized instruction.

In his last IEP document was noted that no significant processing strengths or weaknesses were indicated in the cognitive assessment. Daniel learned best when he was given preferential seating, directions were broken down, and expectations for assignments were clearly stated. Daniel's ADHD impacted his ability to attend to instruction and sustain attention to complete tasks with accuracy. He was placed in a collaborative setting in all academic subjects. The IEP contained two goals that addressed his weaknesses, specifically one writing goal and a school behavior goal related to on task behaviors and passing classwork for credit.

Academic Background and Electives Choice. Daniel was 16 years old, in 11th grade. He earned 20 credits out of 19 attempted, which indicated he received a high school credit while in middle school. His weighted GPA was in the middle range (on a scale from 0 to 4). He was barely passing at the time of data collection in Advanced Algebra class and had a low failing grade in the support/elective segment of the class due to missing classwork assignments. His EOC scores in 9th grade Algebra and 10th grade Geometry were a middle C, he failed 9th and 10th grade Literature, and received a high C in Biology. He took four career tech classes in Junior Reserve Officer's Training Corps (JROTC) and one in Audio and Video Technology and Film (shorten Video-production). During spring semester of 11th grade he took Introduction to Digital Technology class.

Summary

The participants in the study were all boys in 11th grade, enrolled in Advanced Algebra with support class (a remedial type of mathematics class that extended for an entire year as opposed to one semester and for which students received one mathematics credit and one support/elective credit). They were heterogeneous, however, regarding their family background, race/ethnicity, disability and patterns of strengths and weaknesses, elective choice, and level of achievement in academic and elective classes. Table 2 shows a summary of participants' biographical data. Additional information about each student's exceptionality and school achievement is presented in Table 7 from Appendix R.

Table 2

Biographical Data Collected through Biographical Interviews

Name / Category	Armando	Benjamin	Caleb	Daniel
Age	16	16	16	16
Race	Hispanic / Mexico	White American	Black / Kenya	White American / Identifies as Native Indian
Birth status	Immigrant	American	First generation American	American
Living arrangements	With father and stepmother	With both parents	With both parents	Moves every other day to the household of each parent and their family
Siblings	An identical twin; one half-brother living with him from his father's side; and two half-sisters and one half-brother from his mother's side that do not live with him.	An only child	The oldest of 3 boys	Had one biological younger brother, a half-sister from his father, and 3 other stepbrothers from his stepfather's side.
Parents' education and careers	None finished high school. The mother worked in construction; the father in landscaping.	The mother had a master's in Information Technology. The father had a BS in the same field.	Both finished high school in Kenya. The parents continued their education in U.S. The mother had a Bs in Nursing and the father in Systems Engineering.	Mother had a BS in Accounting. Father finished high school and held an electrician certificate.
Classes in which students excelled	Honors Spanish Orchestra	AP Social Studies Honors Literature Chemistry	Chorus	Video-production
Relevant non-academic classes taken	▪3 classes of Honors Spanish ▪2 classes of Orchestra ▪1 Video-Production	▪Genetics ▪4 band classes in 9th and 10th grade	▪2 classes in band ▪5 classes in chorus	▪4 classes in JROTC (Junior Reserve Officers Training Corps)

	▪1 Introduction to Drafting Design Technology	▪Tried 3 introductory career classes in different technical fields	▪1 Intro in Digital Technology class ▪1 Video-Production class

Data Sources

The research design for the current qualitative study included the following data sources: a) in-depth biographical interviews; b) open-ended interviews; c) participant-generated visual representations following two prompts; d) informal conversational interviews; e) focus group interview; f) document review; and g) researcher-generated memos. Those data sources were selected to elicit the most relevant data in answering the overarching research questions and to provide detailed socio-cultural-historical contextual information as it relates to Vygotsky's framework (1978).

In-depth Biographical Interviews

The research used the in-depth interview method to allow the participants to tell their own story. "The purpose of this interview style," expresses Lichtman (2010), "is to hear what the participant has to say in his own words, in his voice, with his language and narrative" (p. 143). It can reveal information that structured interviews or surveys are not able to capture. Through biographical interviews (Appendix D), I collected data relevant to students' family background, subject preference, extracurricular activities, and career interest. Its role was to provide a link between students' context and their perspectives.

Open-ended Interviews

Since every person has unique experiences and stories to tell, the interview constitutes "the main road to multiple realities" (Stake, 1995, p. 64). The focus of the open-ended interview was on topics that support the purpose and goals of the study (Appendix E). Some samples of questions are as follows:

1. Tell me some things about how you feel about mathematics.

2. What are the strengths that you think help you understanding and work though mathematics problems? How do they help you?

3. What are the supports that you feel help you to be successful?

The final question asked students if they had anything they wanted to add (Lichtman, 2010). The open-ended interview was essential in gathering insights into students' thoughts, feelings, and experiences in learning mathematics, their perceived weaknesses and difficulties, the strengths they rely upon, and the supports in place that help them overcome their problems.

Participant-Generated Visual Representations

The purpose of using participant-generated visual representations as a data source was to reveal meanings beyond the written or spoken word which might be hard to articulate otherwise (Haney et. al., 2004). In addition, this method has been infrequently used in educational research (other than art education) or to investigate students' understanding of the educational context; its primarily focus is in general on young children, with little attention given to older students or adolescents (p. 248).

Visual images have the power to reveal socio-cultural aspects of participants' reality (Lichtman, 2010) by "drawing, quite literally, on the insights and perspectives of those who are perhaps the most assiduous observers of school and classroom life, namely, students" (Haney et al., 2004, p. 243). In other words, students can express in illustrations "that which is not easily put into words: the ineffable, the elusive, the not-yet-thought-through, the subconscious" (p. 241).

The following two prompts were administered independently, to elicit students' depictions (Appendix B & C). One outlines how students viewed themselves within the classroom (i.e., current state), the other how students envisioned a supportive learning

environment (i.e., their projections on what supports they would like to see in the classroom). The participants had the option to complete their drawings at school or at home, at their leisure. They were offered no information regarding what materials to use. All participants, however, used a blank piece of paper and chose to draw in pencil or pen. The second prompt was handed out after the representation to the first prompt was collected. The participants returned their drawing(s) to each prompt either the same day or within a few days after it's administration.

1) Think about the kinds of work and activities you do in the classroom. Draw a picture of how a camera will see you when you are learning mathematics in the classroom.

2) Think about the kinds of supports that you need to be successful in learning mathematics. Draw a picture about an imaginary classroom in which you are provided unlimited kinds of features and supports that will help you learn.

Informal Conversational Interviews

This type of interview does not have predetermined questions or wording in which the questions are presented (Patton, 2002). I did outline clarifying questions, however, in order to validate my understanding of participants' answers to in-depth biographical and open-ended interviews, where unclear, and to edify the generation of meanings from participant-generated drawings. Informal conversational interviews have the advantage of being easily matched to individuals and circumstances (p. 349).

In determining what questions to ask, I read first each participant transcribed biographical and open-ended interviews and I examined their self-generated visual representations. Second, I wrote a few organizational researcher-generated memos about the information that I had from each student and what I thought I was missing or was unclear. I looked for a logical way of presenting the data and wrote down additional information I needed

in order to compile a complete portrait of each student that would best support the research question and subquestions. Through informational conversational interviews I sought also to capture students' interpretation of their own drawings as a fidelity measure (i.e., "What does your drawing represent?"). Third, I outlined for each participant independently what additional data I saw missing and/or needing further clarification. Fourth, I scheduled another meeting with each student, of common accord, and I recorded our conversations on a digital device.

Focus Group Interview

The focus group technique "is basically a group interview" used to elicit points of view of subgroups of students (Lichtman, 2010, p. 153). The method is valuable in exploring possible mediating variables and in validating data gathered through other means, providing thus a triangulation method for comparing different perspectives. In addition, the group interaction can draw ideas, stories, and discussions among participates that did not emerge in individual interviews (Lichtman, 2010). The topics sought in the study included: a) views regarding learning differences; b) perceptions about mathematics education; c) opinions about best teaching practices; d) learning experiences that stood out for students; e) views on how technology impacts teaching, learning, and their life; and f) thoughts about a beneficial learning environment.

The focus group interview was scheduled after I collected participant-generated visual representations, in-depth biographical interviews, open-ended interviews, and informal conversational interviews from all participants in the study. The time for the meeting was discussed and agreed upon with all participants. We chose to meet in person before school (specifically from 7:30 to 8:15), in a conference meeting room with which the students were familiar, situated by the main entrance of the school. Three of the students participated in the

session: Armando, Benjamin, and Daniel. Benjamin and Daniel were both in the same mathematics class during second block. Armando took mathematics during first bloc. He and Daniel were peers in the Video-production club.

I asked questions such as: "What helps you learn mathematics? Explain" and "What do you think about the importance of mathematics in today's society? How about related to your career?" (Appendix F). The focus group discussion included other topics relevant to the study for which I did not plan originally, such as, for example, the impact of peers and electronic devices on students' learning. Students answered with reserve in the beginning after which the conversation become fluid, at times with eager exchanges of opinions. During the focus group interview, the participants expressed some similar and some divergent views. They listened politely to each other and took turns in communicating their perspectives.

Document Review

Demographic and disability data were collected via school documents as a basis for document review. Two types of documents were used, one related to public and school records and another one to researcher-generated records (Merriam, 1998). Public records constitute federal and state data and statistical databases that can reveal important statistical information about standardized test results on different groups of students for example, or on the number of students that receive free or reduced lunch in a district or particular school. I collected information from state and district generated public data to document the characteristics of the setting and context in which the study occurred.

Other public documents (i.e., test and classroom grades for each student or IEP information) are specific to each school and accessible to the professional staff that works in each particular school. Public documents are not produced for research purposes, and as such,

using them requires creative thinking and determining authenticity and accuracy (Merriam, 1998, p.121). I used in particular student records (i.e., classroom grades and standardized tests data), IEP information, medical records, and student psycho-educational evaluation data in order to present disability and achievement results for each participant. This data was included in the background information for each participant. It was also used in the results and discussion part of the study.

Researcher-generated records instead are prepared by the researcher. "The specific purpose for generating documents," Merriam (1998) stated," is to learn more about the situation, person, or event being investigated" (p. 119). They include disability data, field notes, and work samples used to analyze and keep track of students' progress, difficulties, and needs. I used such data on a regular basis, as the special education teacher in the classroom. Its primary purpose was to inform my teaching and remediation strategies as well as IEP decisions. For the current study, however, I used those self-generated records as a fidelity device, to help me achieve a clear understanding of the participants in the study, their learning experiences, and their views.

Researcher-Generated Memos

Researcher-generated memos represent "the most useful and powerful sense-making tools at hand" (Miles & Huberman, 1994, p. 72) and were used as theoretical frameworks that tie the data together. At different phases within the analysis process, different variations of memos were used such as: 1) memos about particularities of a case; 2) memos that highlighted alternative hypotheses or explanations; 3) memos that identified a new pattern or confirmed the ones already found; 4) memos that were clarifying in nature; or 5) memos that focused on a theme or metaphor (p. 74). Through a reflective process I was able to create, define, and refine

conceptual categories and as a consequence, make "tentative notes about links between concepts" and draw a sketch of "features important for understanding the setting" (Bailey, 2007, p. 133). Through memos, I outlined ideas, reflections, hunches, and emerging patterns about the participants in the study and their activities and conversations as well as reflections about my own reactions. The memos where both descriptive and analytical. They enabled me to "visualize the moment" during the data analysis, keeping therefore its meaning accurate (Stake, 1995, p. 66).

Data Collection

The selection of students followed the IRB approval. Parental consent and student assent were sought from 20 secondary students with disabilities from two inclusive Advanced Algebra classrooms. In understandable language, the consent/assent letter explained the purpose and duration of the research, the procedures that would be followed for data collection and analysis, and any foreseeable risks and benefits from participating in the research investigation. The entire duration of data collection was of 3 months (i.e., beginning of March to end of May of the school year 2018-2019). The duration of each interview was approximately 20 to 30 minutes, with the focus group interview extending to 40 minutes. Each participant was interviewed 3 times independently on different days, once for the in-depth biographical, once for the open-ended, and once for the informal conversational interview. Including the focus group session, the total number of interviews conducted was 13.

The drawings were administrated first in order to capture students' inner world and "the not-yet-thought-through, the subconscious" (Haney et a., 2004, p. 241) without the influence of interview discussions. The students completed their self-generated visual representations for the first and second prompt, separately, at their own leisure. Besides the prompt itself, they received

no information about what their drawings should contain, how they should be drawn, and what materials the students should use. I left this at their own latitude in order to control for my possible influence on their views. The in-depth biographical interviews followed next (Appendix B), followed by open-ended interviews (Appendix C). Each interview took place before or after school, in a comfortable setting with which the students were accustomed to (i.e., the mathematics classroom, a different classroom used on a regular basis for small group testing, the computer lab, or my office).

All data was collected independently, scheduled one at a time, with each student. I assigned pseudonyms (starting with the letters of the alphabet A, B, C, D) and administered the first prompt in the order the participants turned in their consent and assent forms. The data collection following the first prompt, however, occurred free flowing according to the availability of each student, in order to ensure rapport and partnership in the research process. All interviews were recorded on my phone (i.e. Voice Recorder application) as a memory aid for data analysis. I subsequently transcribed each interview.

Informal conversational interviews were conducted with each student in order to clarify and/or add information that I might have missed during the biographical and open-ended interviews. In addition, I used informal conversational interviews in order to capture students' interpretation of their own drawings as a fidelity measure. I and each student reached an agreement on the time and location for the informal conversation interview, following the same procedures as for the other in-depth biographical and open-ended interviews.

At the end of the data collection period, a focus group session was held. Three of the four students that participated in the study were present for the focus group (i.e., Armando, Benjamin, and Daniel). The purpose of the focus group was to bring the students together and elicit

common and/or different thoughts regarding mathematics through sharing and discussing their perspectives among them. The conversations were recorded on the same electronic device in order to ensure clarity and accuracy of participants' perspectives during the analysis of the data and interpretation of the results. I transcribed the focus group interview. Different data sources were employed in the current study as a method of data triangulation. Planning for and holding each interview, recording the conversations, listening to each recording, transcribing them, and reading and re-reading each transcript, helped me identify patterns in the raw data and find connections between the results and the conceptual framework of the study.

Lastly, I outlined memos on an on-going basis in order to organize the data collected in comprehensible models, charts, figures, and tables. Each section of the study was built on researcher-generated memos. It helped me visualize how data can fit in a comprehensible whole. Document review occurred as well on an on-going basis and was used to retrieve information for specific sections of the study (i.e., setting and context, participant portraits, results, and discussion). Students received no school credit for their participation. They were reminded throughout the entire data collection period (i.e., over the spring semester of the school year 2018-2019) of their free choice to answer all questions, omit some, or elect to fully withdraw.

The hard copies of each signed parental consent and student assent form, visual representations, and data records were stored in a locked metal cabinet, in a locked office at school. Only the parental consent and student assent forms have identifiers and are kept in a different folder from memos and drawings which lack any personal data. Digital documents have no personal identifiers; the data was saved on the hard drive of a school issued computer that has a protected password. The link between assigned pseudonyms and students' real name is not specified on paper or digitally. All documents will be kept for three years after the conclusion of

data collection. After those three years, the hard copies will be shredded; the digital data will be deleted and the recycle bin emptied.

Data Analysis

Data analysis for the current study adopted Miles and Huberman's (1994) systematic approach known as thematic analysis model. It followed three processes that occurred concurrently, namely data reduction, data display, and conclusion drawing. Through data reduction, I decided which data to choose in order to be able to draw an accurate portrait of each student independently. As a first-run data reduction I used flow chart outlines in lieu of summary field-out sheets in order to capture my thoughts and impressions of the data collected at each stage, through each instrument, and for each student. I made several sketches until a logical and complete way to organize the information for each student emerged. Miles and Huberman (1994) recommends this method as an easy way to keep the data organized for further data retrieval and analysis (p. 52). The drawings were interpreted separately for each prompt and for each student. Figure 3 shows the steps I took in analyzing all of the data sources.

Figure 3

Three stages of data-analysis

Within-case analysis
- I read and re-read all interviews.
- Commonalities and differences were observed acorss students' testiminials.
- Tenative codes were assigned to pieces of information.
- I outlined an independent portrayal of each student's context as a summary sheet that I further expanded into a linear account of each student perspectives.
- Detailed explanations of students' drawings were done separately for each prompt. The data collected through interviews and visual representations were used as a triangulation device.

Cross-case analysis
- From within-case analysis common codes started to emerge.
- I highlighted the sentences/passages with different colors for easy retrieval.
- The data from each student was compared and contrasted looking for commonalites and differences across the answers of all students which yelded to pattern coding.
- I jotted down a few graphic organizers / tables in order to find the themes and sub-themes that best represent the data.
- A logical chain of evidence was found that provided the backbone for writing the cross-case analysis.

Analysis within Vygotsky's framework (1978)
- I went back to Vygotsky's framework (1978) and I re-read the raw data and the themes from cross-case analysis.
- Again I organized data into a few logical configurations.
- I chose the visual representation of the data in which the link between the themes and the socio-cultural-historical model (1978) appeard to fit best and was the most comprehensive yet parsimonious.
- Each theme was then explained in the light of the framework.

As themes emerged, codes were attached to words, sentences, and block paragraphs. For creating codes, I read the transcripts, reviewed documents, and my memos paying attention for words, expressions, or ideas that repeated as well as for contradictions that needed to be further clarified (Miles & Huberman, 1994, p. 58).

In the first stage of coding, I assigned codes that describe the phenomena under investigation. Examples of codes are: expressed difficulty in mathematics, socio-cultural-historical supports, views on learning differences, and weaknesses in learning mathematics. In the second stage, I further distinguished subcategories. For socio-cultural-historical support, for example, the data showed several indicators such as family, teacher, peers, and elective/extracurricular activities.

The second stage included pattern coding, a process that is explanatory and inferential rather than descriptive in nature. I looked "for consistency in certain conditions" and for "corroborating incidents and disconfirming them" (Stake, 1995, p. 77). Searching for patterns, relationships, and causality helped me summarize the data into analytic units or themes, focus the analysis on the go, develop conceptual schemas or "cognitive maps", and lay "the groundwork for cross-case analysis" (Miles & Huberman, 1994, p. 69).

Depending on the words and information included, each sentence/paragraph received one or more codes. Not every line was coded as students provided at times data unrelated to the subject of the investigation. A check-coding strategy was used about two thirds of the way of the data analysis (p. 64). This process ensured the reliability of the assigned meanings of the codes.

Throughout the data collection and data analysis process, graphic organizers and flow charts were created as a generalized way of compacting and displaying the data in an organized and concise manner. They kept track of the emerging themes and the narrative stream. Finally, I was able to draw conclusions from those evolving configurations, relationships, and patterns in the data, in relation to Vygotsky's conceptual framework (1978).

The accuracy of my conclusions was corroborated through triangulation methods (i.e., instrument; class; or verification with the existing literature) and through revisiting the data collected in order to ensure the study's plausibility, sturdiness, and confirmability (Miles & Huberman, 1994, p. 11). All three streams of analysis occurred as an iterative process until the final review of the research. The data collected through several instruments contributed to an iterative re-visitation of the profile of each case until a clear portrait emerged. Each transcript, visual representation, review document, and researcher-generated memos were used as a crosschecking device. Data collection and analysis started in March of 2019 and continued until

November of the same year (16-20 weeks are recommended by Miles & Huberman's, 1994, p. 47).

Ethical Considerations

Ethical dilemmas in conducting research with human subjects create tensions "between the aims of research to make generalizations for the good of others, and the rights of participants to maintain privacy" (Orb et al., 2001, p. 93). Ethical considerations enter at each stage of the research process. They can be distinguished as: 1) procedural ethics (soundness of the research design, research protocols, informed and assent forms, gaining approval); 2) situational ethics (occurring in the process and as related to the research context); 3) ethical relationships (the dynamics between the researcher and the participants); 4) researcher transparency ethics (subjectivity and bias statements); and 5) ethical issues in exiting the study (completion and dissemination of results; Reid, et al., 2018).

Guidelines of ethical behavior are based on several established philosophical principles known as: 1) beneficence (do good) and non-maleficence (do no harm); 2) respect for autonomy and self-determination; and 3) equity or justice (Foster & Timothy, 2007; Howe & Moses, 1999; Konza, 2012). In order to ensure beneficence, I safeguarded the protection of participants' identities by using pseudonyms; I am keeping all data secure, apart from any personal identifiers; and I will ensure the proper discharge of the information. Students were asked for approval of the "quotations" and the interpretations of their answers in the results section. In enforcing the ethical principle of autonomy, I disclosed to parents and students the nature and purpose of the research, offering them the opportunity to choose freely whether or not to participate in the study and the right to withdraw at any time without penalty. Finally, I constantly confronted my biases in my interactions and ensured fair treatment of all students, without favoring or disadvantaging

anyone, regardless of their choice to participate, withdraw, or elect not to take part in the study. Also, the principle of justice was addressed through listening to the voices of historically disadvantaged groups of students (Orb et al., 2001, p. 96).

Three ethical dilemmas were especially relevant to the current inquiry. First, in the context of the study, my role as a researcher overlapped with the one of the special education teacher in the classroom (i.e. full participant, Glense, 2006, p. 50). I set forth, therefore, diligent effort to respond ethically to teaching and researching aims and demands, "managing power dynamics, role conflict, and role boundaries" between me and my students in my dual role (Reid et al., 2018, p. 72), giving primacy to my teaching responsibilities.

The conflict between students completing learning and research tasks was minimized by conducting the research activities with each participant before or after school. I met Armando, Benjamin, Caleb, and Daniel independently three times. I conducted one interview at a time (i.e., one for in-depth biographical, one for open-ended interview, and one for informal conversational). Each interview took approximately 20 to 30 minutes. I met each student individually either before or after school, in a location familiar to him (i.e. the mathematics classroom, an alternative class we used for small group testing, the computer lab, or my office). The focus group interview occurred for a duration of approximately 40 minutes, in a conference room located at the entrance of the high school. Only three of the four students participated in the focus group interview (i.e., Armando, Benjamin, and Daniel).

In addition, I adhered to ethical components related to special education practice which was "developed largely from a commitment to ethical requirements" (Mertens & McLaughin, 1995, p. 83) and as highlighted in IDEA (2004; i.e., free and appropriate public education,

appropriate evaluation, individualized educational program, and least restrictive environment, privacy and confidentiality requirements).

The second ethical consideration was related to the "power asymmetry" that I, as the researcher, am assumed to hold over my students through my position as the classroom team teacher and through holding control over the research process (Reid et al., 2018, p. 73). Other researchers (Glense, 2006; Konza, 2014) argue, nonetheless, that the power relationship is dynamic and co-constructed. As the teacher of the classroom, I had a previously established open and honest relationship with my students. I continued to informally re-negotiate a sense of cooperation and partnership through which "respect, interest, and acceptance" grew for both myself as the researcher/teacher and my participants/students (Glense, 2006, p. 133). The power imbalance was addressed as well through giving my students the option to withdraw at any time without penalty.

Finally, the third ethical dilemma specific to the current study was related to my cultural background. Glense (2006) discovered while working in Oaxaca, Mexico, a different relationship connection between researcher and participants, with an emphasis on "exchanges of care, compassion, and generosity." As a white minority, naturalized immigrant, from a Latin culture, I identified with the lens of "hospitality as an ethical framework for conducting research" rather than with the one of power (p. 145). Belonging to a different culture than the participants in the study presented some advantages and disadvantages. On one hand, I was able to listen to students' stories from an outside socio-cultural-historical position, allowing diverse voices to express and co-exist freely, approaching the context from a different angle, and capturing understandings that an insider might overlook. On the other hand, I may have overlooked some language, cultural, social, and historical aspects of the reality I strived to investigate.

Validity Considerations

Judging the quality of qualitative findings depends on the criteria, definition, terms, and philosophical framework chosen. The current study took in consideration a traditional scientific research criterion which "emphasizes procedures for minimizing investigator bias" (Patton, 2002, p. 544). It follows the following qualitative validation norms: a) credibility and trustworthiness (confidence in the findings); b) transferability (the results are applicable to other contexts); c) dependability (the results can be replicated); and d) confirmability (the findings result from data, not from biases; Guba, 1981).

To establish and maintain the credibility of the study, I implemented four primary strategies. First, I portrayed accurately the setting, context, and participants by becoming familiar with students in the classroom and their culture as well as the one of the school. Second, I revealed my subjectivity and positionality through which biases could have permeated the study. Third, students were allowed the option to refuse or withdraw at any time without penalty. Lastly, I applied different methods of triangulation.

In the current study, triangulation was achieved by using the following methods: 1) utilizing the literature review to confirm or refute the conclusions of the study; 2) employing different data sources (i.e., interviews, visual representations, document review); 3) having participants with different disabilities, backgrounds, and from two different classes; 4) checking the accurate representation of participants' responses through clarifying questions; 5) memoing to revitalize memory; and 6) addressing feedback from the committee members.

Transferability represents the degree to which the results of a qualitative study can be transferred to other contexts, circumstances, and participants. It is the equivalent of generalizability from quantitative research. Shenton (2004) expressed, "after perusing the

description within the research report of the context in which the work was undertaken, readers must determine how far they can be confident in transferring to other situations the results and conclusions presented" (p. 70). In order to facilitate transferability, therefore, I described in detail the number and characteristics of the participants involved in the study; the instruments and data collection methods used; the number and length of the data collection sessions; and the time period over which the data was collected.

Providing in-depth detail and coverage of each step of the study will allow the readers to develop a thorough "understanding of the methods and their effectiveness" and warrant its dependability feature (Shenton, 2004). The study included the research design in order to show the steps of the research process; the operational detail of data gathering, specifying accurately what was done in the field; and a reflective appraisal of the project, evaluating the effectiveness of the process of inquiry undertaken.

The last validity measure was related to the steps taken "to help ensure as far as possible that the research findings are the result of the experiences and ideas of the informants, rather than the characteristics and preferences of the researcher" (Shenton, 2004, p. 10). Triangulation had an essential role in promoting confirmability. In addition, I acknowledged the decisions made and the methods adopted as well as the possible weaknesses in the techniques employed in order to support the confirmability of the study.

Researcher's Positionality

I was born in the mountains of Transylvania, Romania, during the communist regime. At 8 I started to write. By 15 I already penned over 50 works, mostly poems. In middle school, I was deemed talented in the visual arts and my art educator, himself an artist, made the effort to come and talk to my parents to let me attend the local gifted school for the arts. Following an

unsuccessful coup d'état, the president at the time dismantled many educational programs including art, philosophy, and psychology majors. I was unable therefore to continue my studies in what I loved most – art.

I remember being in high school and feeling that something was wrong with me. I couldn't tell why I was extremely anxious and why I couldn't perform at the level I knew I could. I wished I had someone to talk to, but our schools had no counselors. From the information I gathered at the time from studies conducted outside the country, I suffered from Attention Deficit Disorder. Now I know I had a double exceptionality – I was a gifted student with a disability and I required support. Although I always achieved at a B level in school, I perceived I had an insurmountable problem. My self-image was not that of a B student. I struggled to learn how to balance conflicting thoughts about who and what I was and how to tap into my true potential. Not being able to pursue my passion in the visual arts – something I was particularly good at – added to my feelings of frustration and helplessness. I had some poems and short stories published in my youth, I wrote for the college newspaper, and I got the chance to participate in some group exhibits. It was sporadic, however, not enough to give me hope for a possible breakthrough.

I was a teenager when the communist oppressive grip on my country was at its worst economically, socially, and politically. As a college student, I participated in the revolution that ended the dictatorship, exposing myself to a life in prison if the insurgency was to be unsuccessful. I didn't die by chance. And, during the murky times following the post-communist era, I was too young and inexperienced to know how to fight a broken system and thrive. At a time in everyone's life when their dreams catch fire and their career flourishes, every door I tried closed in my face. It seemed as if I wasn't at the right time, in the right place.

Not being able to pursue art, I had to re-orient myself and studied engineering instead. By the time I finished the University, the communist regime fell and the new trends in society were discriminatory towards women. Companies would not hire female engineers, period. I re-oriented myself and pursued 4 more years of college, this time in psychology. I was 30 years old, when the opportunity to immigrate to U.S. presented itself. I took the chance to search for a better life although it meant leaving behind a 7-month-old baby. I couldn't see him for the following 3 years. Once in U.S., I got admitted into a master's program in applied psychology. As an immigrant I went from holding a visitor visa, to a student visa, and to a dependent visa on my husband's work permit. Unfortunately, without a green card I was not able to secure a job upon completion of my masters' degree.

Family difficulties became acute and my husband abandoned me. At that time, I was battling clinical depression, I had an 8-year-old child and a new-born baby, no friends, and no job. Somehow, I got a teaching position and pursued an additional 2-year certification program. I chose to teach mathematics due to my engineering background and special education due to my psychology studies and interest.

Fourteen years later, I continue to work in a high school as a special education teacher. It was never my dream yet, I found joy in it. I love seeing students of different colors, backgrounds, and disabilities together in inclusion classes. I strive to encourage and build up my students as competent and resourceful individuals. I care to connect and develop positive relationship with them, their parents, and my colleagues. I want to assist my students in learning mathematics and far above it, in discovering their best selves. I am trying to be for them exactly that which I needed when I was at their age – a person that would believe in my potential and would guide

me towards seeing the possibility of achieving what I dreamed of in spite of my shortcomings and life's inherent barriers.

The profession brings me a lot of unsettled ache as well. My heart hurts seeing minority and disability students being pushed towards low-level classes. I know they are not held to the same expectations as their non-disabled counterparts. I also know that the level of the mathematics curricula offered does not allow them access to higher-level classes which in turn limits their career choices. I am in particular distressed when students with disabilities (and minority for that matter) that express an interest in a technical/engineering career and show average to high levels of achievement in low-level classes, are not encouraged and/or supported to access higher-level mathematics classes. Above all, I see how students with disabilities are disfranchised, disparaged, and let down subtly, implicitly, most times without bad intention, most times disguised under a "care" heading. The way they are regarded, talked about, and positioned within the school environment points to such biases. Inadvertently, it manifests as a new form of segregation in which students with disabilities are marginalized yet "included" in the lowest academic level available.

My diverse background allows me a unique approach to reaching students. Having relatively high mathematics skills and coming from a different language and culture, I was able to notice that only the end result of mathematics is internationally analogous. The cultural imprint is seen in the way one approaches the problems conceptually, and in the propensity and easiness to learn a procedural way versus another. This insight in itself allows me to be flexible in my approach to teaching mathematics. In addition, how mathematics is viewed in society has a high impact on the values people hold about the subject's significance and further, in the effort students are willing to set forth in order to learn it. By high school level, students' past

experiences with mathematics shape a certain self-image as mathematics learners, manifested often in the form of insecurity in one's ability to succeed. Many times, therefore, I find it more important to work first in changing students' mindsets and resistance towards mathematics before attempting to implement any learning strategy.

Within the school setting and the society, I position myself as an underprivileged professional. First, because as a special education teacher I perceive I do not have the same status as other teachers in the eyes of the students, the general education teachers, the administrators, and the general population. Most students in my classes do not know I am a teacher. I have been referred to as being a helper, paraprofessional, student teacher, or a teacher's assistant. Although the title assigned to me is irrelevant, the diminished respect students and other professionals hold of me, is not. Second, the work I do behind the scenes is not seen or recognized. My opinions are rarely taken into consideration. Third, although I have white skin and come from a Latin culture, I am neither white nor a minority of any race or ethnicity. I assimilated as an immigrant, yet I have a thick accent and lack some language, as well as social, cultural, political, and economic awareness that people learn implicitly growing up in this country. As such, it is easy for me to feel left out or like an outsider. Yet, I consider myself privileged to have a good job and to live decently, at a time of peace, and in the most affluent country in the world.

As I lived through and suffered intensely from oppression, I can affirm I know how it looks, how it feels, and what it does to a person's confidence, path choice, and success in life. In addition, although I have white skin and light eyes, I come from a nation that was over and again subjugated by other nations. I carry on my shoulders, therefore, the pain caused by unfair life circumstances, of my ancestors as well as my own; I believe each student carries the burden of their own challenges. I do believe our life is bound by the context in which we are situated. In

my view, therefore, our life is not just the product of our own abilities and disabilities, effort and lack of effort, but equally so of the opportunities and lack of opportunities that are culturally, socially, and historically determined.

Through my research I would like to uncover how students with disabilities are able to thrive in life regardless of their vulnerabilities and restricting circumstances. Moreover, through my research I would like to bring awareness to their thoughts and feelings, how they cope and are able to surpass difficulties and emerge as complex, well-rounded, successful individuals. In the end, I do believe that environmental conditions are more disabling to students' learning and development than any disability in itself and that our society would benefit from addressing those socio-cultural-historical injustices collectivity. Unfortunately, although the rights and protection of people with disabilities is a socio-cultural-historical issue, we address it politically. Support should be offered to students according to their needs which would reflect, not the implementation of a just law or unbiased policies but rather a kind, considerate, and inclusive type of culture and society.

Summary

The research design of this study is characterized by a qualitative paradigm based on case study methods. Discussed was the process undertaken to answer the overarching research question, a justification of the research design, an explanation for accessing the research site, selecting the participants, and collecting and analyzing the data. Data sources included in-depth biographical interviews, open-ended interviews, participant-generated visual representations, informal conversational interviews, a focus group interview, document review, and researcher-generated memos.

The methodology chapter concluded with ethical considerations and how they were addressed throughout the study, as well as how validity and triangulation measures were applied to increase the trustworthiness and credibility of the results and findings. Researcher's positionality was disclosed in order to reveal the social, cultural, and historical context of my identity as a person, researcher, and teacher, as well as how it impacts my view of the world, of teaching, and of research. The triangulation methods included utilizing varied types of data sources and a sample of participants with different backgrounds and disabilities from two different mathematics classes; memoing to revitalize memory; checking the accurate understanding of students' responses by asking clarifying questions; scrutiny and feedback from the committee members; and findings that either support or refute the relevant literature as presented within chapter two.

The results of the data analysis are provided in chapter four. Chapter five provides a summary of the study; a discussion of the findings within Vygotsky's socio-cultural-historical framework (1978); limitations and delimitations of the study; implications for practice, policy, and research; recommendations for future research; and the conclusion.

Chapter Four: Results

Chapter four presents the results for the current study, which seek to answer the following overarching research question: How do students with disabilities experience the process of learning complex mathematics in an inclusion class at the secondary level? The chapter is divided in three sections. The first section includes an in-depth portrayal of each participant's perceptions on learning complex mathematics (Patton, 2002). Four individual accounts or "cases" (Stake, 1995) – one for each participant – will be presented from data gathered through biographical, open-ended, informal conversational, and focus group interviews.

The second section focuses on participants' self-generated drawings to two prompts (see Appendix B and C) and their interpretations of those drawings as clarified in informal conversational interviews. Information gathered through different data collection sources (i.e., interviews and self-generated drawings) are used as a triangulation method. The first two sections of chapter four provide the reader with a background sense of each participant's perspectives regarding learning complex mathematics (Ayers et al., 2003, p. 874). The third section consists of cross-case analysis results. Findings and interrelated themes that emerged from reading and coding the within-case data will be presented.

Interviews Analysis

The first section is divided in four parts corresponding to the four students that volunteered to participate in the study: Armando, Benjamin, Caleb, and Daniel. Each section will begin with general background information about each student's interests gathered through biographical interviews, grouped under the headings: a) favorite/least favorite class; b) extracurricular endeavors; c) career interests; and d) perceived link between interests and mathematics. It continues with each participant's responses gathered through biographical, open-

ended, informal conversational, and focus group interviews organized according to the research sub-questions, specifically:

1) How do students with disabilities successfully navigate the challenges they face in learning mathematics at the secondary level?

2) How do students with disabilities perceive their own learning differences within a mathematics class at the secondary level?

3) How do students with disabilities envision an educational environment they would call academically supportive at the secondary level?

For brevity purposes, the students' contextual data regarding their interests and the research subquestions were shortened to the following headings: a) background information; b) challenges in learning mathematics; c) perceptions regarding learning differences; and d) perspectives regarding a supportive learning environment. The challenges in learning mathematics are further subdivided in perceptions, vulnerabilities, and assets in learning complex mathematics at secondary level (see Figure 4).

Figure 4

Relevant topics of inquiry for each participant in the study

A. Background Information	How do students with disabilities successfully navigate the challenges they face in learning mathematics at the secondary level?	How do students with disabilities perceive their own learning differences within a mathematics class at the secondary level?	How do students with disabilities envision an educational environment they would call academically supportive at the secondary level?
Favorite / Leas Favorite Class	B. Challanges in Learning Mathematics	C. Perspectives Regarding Learning Differences	D. Perspectves Regarding an Accedemically Supportive Learning Environment
Extracuricular Endeavors	1. Perceptions of learning mathematics		
Career Interests	2. Perceived vulnerabilities in learning mathematics		
Perceived link of interets and mathematics	3. Perceived assets in learning mathematics		

Armando: English Learner with Learning Disability

Background Information.

Favorite/Least Favorite Class. When asked what his favorite class was, Armando replied,

> For right now, I could say like math cause, you know, I really feel like, I really feel you know… right now I really feel smart, you know, I feel confident in what I do, you know… and I feel that I have grown more since my freshman year. (Armando, personal communication, March 27, 2019)

His least favorite class was Zoology. He explained, "cause sometimes is harder for me to understand those kinds of topics, you know… cause I am not really into, you know, learning about animals, you know, all that Zoology." He was unsure if vocabulary might contribute to his disliking of this class, since English is not his first language. "I could say," he stated, "I get a

little bit out of task but most of the times it is because I don't understand those types of subjects"

(Armando, personal communication, March 27, 2019). The lack of interest in the topic, however,

in conjunction with the lack of comprehension of the material being taught was evident in his

interview.

Extracurricular Activities. Armando participated in a few extracurricular endeavors.

Besides attending regularly church service on Sundays, Armando goes every Tuesday and

Thursdays before school to the Video-production club. Talking about what activities they

perform, Armando stated, "We record games, we record news packages, you know…we're into

picture room, we're into cameras, you know… T.B. [the name of the school news program], you

know, school's news, we help out, you know..." And continued, "It is not easy sometimes, you

know, cause it is difficult dealing with all this stuff" (Armando, personal communication, March

27, 2019).

He was also involved in the Architecture, Construction, and Engineering (ACE)

mentorship program offered after school. It was a program led by professional adults who

volunteer to mentor students for careers in architecture, construction, and engineering. With great

enthusiasm, Armando shared, "…they have invited people from LSU [local university]… they

have invited students and people that have experience and stuff, you know, to inspire us and all

that, you know…" Additionally, the club had a field trip to a construction site which gave

Armando and his peers involved in the program the opportunity to gain real-life, on the job

knowledge and experience.

In addition to extracurricular activities, Armando assisted his father in completing tasks at

work. He expressed, "sometimes I work with my father. He says [the father], you know, 'You

want to go work with me, you know, help me out a little bit?' I'll be, 'Sure, yeah…'" When

asked how he helps his father, Armando disclosed, "mow the lawn, help him out with other clients, you know, with communication also." He admits, "that's why I am trying, you know, I am trying to be worthy, to be successful, you know…" (Armando, personal communication, March 27, 2019).

Career Interests. Armando's career interests were connected to the activities he was already participating in. His first choice for a future profession was in architecture. As a second choice, he indicated a closely related profession, "probably the same, in the construction industry, yeah, I could say, project manager." He considered broadcasting as his third choice. When asked why he would like to work in architecture, he answered,

I don't know, cause I've seen a lot of videos and I've seen since like… I like drawing. And I know that it is not all about drawing, it is all about, you know, creative (struggles to pronounce), creativity, you know, all that… I don't know like, just like, I am not doing it cause of the money – cause they told me that, they told me that. It is not about the money and all that, it is about what you love. You are doing what you love! (Armando, personal communication, March 27, 2019)

Perceived Connection of Interests and Mathematics. Armando was able to articulate a well-defined way in which his passion for architecture connected with mathematics, and how his interests motivated him to achieve a higher grade in class. In his opinion, Architecture, Construction, and Engineering (ACE) mentorship helped him understand the importance of learning mathematics:

…like pay more attention to math… Like if I am doing like, like when I am there drawing or making a floor plan, I will be like… cause when the other partner is asking, 'Hey, how many inches do you want this?' I will just be like, 'Man, you need to pay more

attention into class! This is gonna help you so get more into math'… you know, it helps

me like say, 'Hey, I am going to pay more attention to math!' So, yes, it does actually

help me in that way, in that way, you know… (Armando, personal communication,

March 27, 2019)

Moreover, group and teamwork appeared to be of high importance in motivating

Armando to invest effort in his curricular and extracurricular endeavors, in his current and future

pathway, and ultimately in what he saw as success in school and in life. The following excerpt

exemplifies well this preference:

For me is not about solving problems, you know, it's about, you know, working with

others. And in T.B. [the Video-production club's name] we work with others, we don't

only… do only like math, solving problems, but we work with others, you know… We

respect each other, that's how we are going to succeed, you know, communicate, you

know, with others… (Armando, personal communication, March 27, 2019)

Challenges in Learning Mathematics.

Perceptions Regarding Learning Mathematics. When asked how he currently felt about

his experiences in learning mathematics, Armando demonstrated enthusiasm: "Mathematics right

now, this year, I feel really good, really, really confident, I feel really happy, really trilled…" He

further shared how he experienced growth in his confidence and mathematics achievement his

junior year as opposed to previous years:

Cause I've grown a lot… I feel like I have grown a lot. Since freshman year, first

semester, my grades were like… I don't know… I feel like I was, I feel like I was failing,

you know, I feel like I couldn't do it. But since, I started growing my sophomore year and

my junior year and now I feel like I have grown a lot, you know… I feel like I really have

grown and that's what I feel about me, you know… I feel proud of myself… (Armando,

personal communication, April 05, 2019)

Vulnerabilities in Learning Mathematics. Armando indicated that he struggled for many

years with mathematics. During 11th grade, however, he experienced a breakthrough, which

allowed him to grow motivationally, socially, emotionally, and in consequence academically. "I

could say a teacher made a difference," Armando voiced, indicating how this progress became

possible due to the support received from a special education teacher. Further he uttered, "Some

teachers teach differently, some teachers inspire you, some teachers… you know, they, they

personally come up to you, see if you need help, you know…" In his opinion, the personal touch

of a special education teacher had a positive impact on his transformation from having low

grades in mathematics and doubting his mathematical ability, to achieving high grades (i.e., B's

and A's) and reaching confidence in his knowledge and skills. "That's what makes me proud,"

Armando stated, "cause not any teacher says that to me, not any teacher says: 'You can do

this'… Not any teacher says that. So, I am really happy, it actually helps me, you know…"

(Armando, personal communication, April 05, 2019).

If the simple reassuring words, "You can do it," made a difference in increasing

Armando's self-assurance, his motivation to learn mathematics, and his performance level in the

classroom overall, the opposite was responsible for his past challenges:

Like sometimes teachers don't go clearly. But I could still say like my freshman year… I

could say I kind of struggled a lot there… cause, I guess my teachers just wouldn't be

telling me, aaa, aaa… wouldn't come to me personally to be saying, 'Hey man, you need

any help? Hey man, you know…' So, basically that was the problem... Like he would,

they were kind of like, aaa… let's not say ignore but… (Armando, personal

communication, April 05, 2019)

Furthermore, Armando was able to voice with clarity his personal vulnerabilities that

contributed to his difficulties in learning mathematics, adding to an external lack of support from

past teachers. He indicated, for example, memory as a vulnerability that hindered his

mathematics learning. "Sometimes my brain," he specified, "is like 'What's the next step, what's

the next step?'" Armando identified "not paying attention" as interfering at times with his

learning. In addition, he expressed difficulties understanding a topic the first time exposed to it.

Armando's initial struggles with new material may indicate challenges in generalizing concepts

from previously learned material and applying them to new situations. He expressed how the

support of a special education teacher was instrumental in helping him overcome this barrier:

> For example, I ask you [the insider researcher as the special education teacher in the
>
> classroom]. I am talking about… when I say that, I am talking about the first time a unit
>
> comes. Not when a teacher reviews [the material] … This is the first time we are doing
>
> new, something new… And they'll [teachers] be like, 'Ok, now it is your turn, you do
>
> it!'… And I get stuck, but this is just the first time but when they start helping me, second
>
> time, there's no problem. (Armando, personal communication, April 05, 2019)

In another passage, Armando expressed the same difficulty in being able to connect

previously learned information to a new lessons: "…when a new unit comes, the first time when

I see it, it doesn't come to my mind, 'Oh, do this, do this, do this'… sometimes I show a little bit,

'Oh, I forgot how to do this, and how to do this'" (Armando, personal communication, April 05,

2019). In addition, Armando expressed some challenges with problems presented in worded

format. He stated, "when it is like a sentence and it shows like math problems, you know, I kind

of get like confused on that… It is much better if I see like, like just normal numbers, you know"
(Armando, personal communication, April 12, 2019).

Assets in Learning Mathematics. While Armando was clear in describing his personal
vulnerabilities and the way they may impede his learning mathematics, it appeared harder for
him to name, with equal clarity, his personal assets that help him navigate through those
challenges. In his opinion, the strength he relied upon the most was listening:

> Yeah, that's my strength, listening but like… cause, for example, if I don't listen in the
> math class, I am not learning anything, I mean I am not going to… like, 'How do you do
> this? How do you do this?' Like… you know, that's way listening… I could say cause
> like… ammm… The majority of the times when the teachers call like, on other students
> when they are not listening, they are on the phones or anything, they don't know what
> they are doing. They ask questions, they raise their hands… But if you see the ones that
> are listening, they're not gonna do that, you're gonna see improvement in there. So, that's
> kind of one of the strengths I have… listening, you know… (Armando, personal
> communication, April 05, 2019)

In the excerpt above, Armando indicated his view on what successful and unsuccessful
learning behavior is from a student's perspective. In his view, the students who are mentally open
to learn, in other words who "listen" to the lesson, are likely to show improvement. On the other
hand, students who do not engage with the material being taught in class and let themselves get
distracted by their phones or peers, may not be able master the concepts. In describing how
student learning should look, he placed responsibility on the shoulders of the students
themselves.

Armando designated other characteristics related to "listening" and attending to the lesson as strengths, such as "paying attention" and not being "that much talkative." Another positive school behavior that helped him succeed in mathematics was completing classwork:

> The way I work, I could say that, yeah… I do finish my work the same day as aaa… I do finish the work the same day as aaa… when the teacher passes out the sheets, I finish it the same day, you know! (Armando, personal communication, April 05, 2019)

Armando understood, therefore, the importance of staying on task and doing his best to finish the work by teacher's deadline. He seemed to take pride in being involved in his schoolwork and in turning assignments in a timely manner.

Perspectives Regarding Learning Differences. When asked about learning differences, Armando shared a positive view of how he thinks differently than his classmates. Moreover, he perceived his peers as having difficulties in learning. He stated, "I do solve problems differently than others cause I really see, aaa… it is not that I'll be looking at the other peers but I've been looking at them, and sometimes you know, sometimes they really do not understand, right, and… even I have to help them out a little bit, right?" Armando's perception, therefore, of personal growth in mathematics computation and reasoning empowered him to think in a different and constructive way, with a newly found sense of competence. In addition, he used his knowledge to help his peers do well. Probing further into how he solves problems differently Armando expressed,

> Aaa… I could say the teacher teaches the same thing to everybody, you know so, I could say, I could say they are solving differently… I could say like… aaa… like for example, like sometimes you [the insider researcher as the special education in the classroom] have taught me shortcuts, you know... how to do this… You have taught me real shortcuts…

differently than what the teacher [general education teacher in the classroom] teaches
us… sometimes I get confused, you know… and you are like… "Do this, do this, do
this…" a shortcut, you know, that maybe others do not even, aaa… solve it that way, you
know… (Armando, personal communication, April 05, 2019)

His opinion about disability was simply that "everybody has them [difficulties], you
know!" Further he stated, "it doesn't matter, you know, nobody is perfect, you know…" In his
assessment, learning differences should not keep anybody from reaching one's goal:

It really doesn't [matter], it doesn't cause you know, anybody can do like aaa… you
know, if they're really, you know, really into it, you know, if they really care about their
education, then they will to be willing to like try, you know, and not give up, you know.
(Armando, personal communication, April 12, 2019)

Although he perceived he was "tripping of" at times on word problems, he didn't
distinguish this difficulty as a personal vulnerability or a learning difference. He was aware other
students "say they don't like word problems" and experienced challenges solving them
(Armando, personal communication, April 12, 2019).

Perspectives Regarding a Supportive Learning Environment. Armando indicated
repeatedly the high importance teachers played in his past challenges and recent growth in
learning complex mathematics (i.e., motivational, emotional, social, and academic). He spoke,
however, about other ways in which teaching and learning can be improved. For example,
responding to the high number of worksheets that he had to complete during class he stated,
"We'll [we, students] be just like, 'Man, like, let's try something new, you know, let's try
something new!'" Armando indicated that some "projects" might help break the monotony of
doing independent worksheet assignments.

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Armando's preferred learning strategy and/or practice was group work in which students can discuss problems and help each other. Explaining his self-generated drawing for the second prompt, in which he had to draw how he sees an environment supportive of his learning, Armando shared,

> Aaa… me personally I think that working in groups, working with each other aaa… we gonna have more aaa… you know, aaa… like know how to do questions, you know, like the aaa… like teamwork, you know and all that. Like, you can help me, you know, like a little bit more, you know. (Armando, personal communication, April 12, 2019)

When asked about his opinion regarding technology use, Armando indicated that it "has grown" and that it seemed easier to "focus on the computer." "You can even learn from it, you know," Armando expressed, "cause some people, that's how some people do home school and stuff." He mentioned some technology devices used in the classroom such as the projector and Promethean board, available throughout the school in the newer classes. He stated, "it's going be good to, you know aaa… the upcoming kids that are coming [will benefit from it], you know" (Armando, personal communication, April 12, 2019). Although Armando indicated the possible usefulness of computers in learning, he questioned at the same time the ability of digital technology to provide groupwork opportunities:

> I don't think we can see group work right there [using the computer] cause we are not basically, we are not basically, you know, like… unless we are doing like a project then all of us have to like aaa… do a certain part. There won't be like, like that much communication as… as a worksheet you know, cause when you are doing worksheets you, you pay attention to others but when you are at the computer that's like, that's like a

distraction right there. You, you… you see the computer more than you are your

teammates. (Armando, personal communication, April 12, 2019)

Benjamin: Gifted Student with Autism

Background Information.

Favorite/Least Favorite Class. Benjamin expressed he had "a natural thing for liking

historical events and what happened in the past" (biographical interview) and had no difficulties

memorizing years and events as they occurred "in chronological order." Although at the time of

the study his least favorite subject was French, Benjamin admitted that in general, he did not like

mathematics. He mentioned a few reasons for his dislike of mathematics:

Algebra is a bit convoluted and whenever are we gonna use it very often unless we go

into a specific job or career and… Geometry we use more often, so I see use for that. I

actually really did enjoy Geometry; I did good in that class. Not that I don't enjoy

Advanced Algebra, I actually do but… yeah… (Benjamin, personal communication,

April 06, 2019)

Extracurricular Activities. As extracurricular activities Benjamin engaged in yearlong

swimming. He trained from 4:15 to 7:15 every night, and Saturday mornings as well. The only

day he did not swim was Sunday. This intensive swimming schedule deterred him from pursuing

other interests, such as being part of the Model United Nations club (focused on international

political issues, viewpoints from a specific country, resolutions development, research, and

debating skills) which was in line with his passion for history.

Career Interests. As a future career, Benjamin was interested in two paths. "I am

considering education and I am considering politics," he indicated. As an education career, he

thought about a History concentration in secondary education. He showed an interest in a politics

major as well but was unsure what career he could pursue. He conveyed, "You cannot just be like, 'Oh, I am gonna go and get a job to be a Mayor!'" Benjamin was comfortable with the idea that he might have "to run for many offices" and "appeal to the masses." He perceived "running for a local community and raising up from there" as fun. He was truly "very heavily interested in politics" as a subject (Benjamin, personal communication, April 06, 2019).

Perceived Connection of Interests and Mathematics. Benjamin did not see a link between his interests (i.e., history or politics) and extracurricular activity (i.e., swimming) and mathematics or the problem-solving part of mathematics. He enjoyed swimming because "it is more of an individualistic sport." He continued his explanation, "You are still with a team but is definitely the individual that counts. You don't have like to rely on your teammates for anything." In the last statement, Benjamin attested his preference for independent work in which he can control the outcome of his own actions and effort. He understood that occasionally his effort in swimming might help him "motivation wise."

Perspectives on Learning Mathematics.

Challenges in Learning Mathematics. When asked why he doesn't like mathematics, Benjamin stated, "…it takes me a lot to understand topics and everything… I do understand but, it takes more time than others to understand it" (Benjamin, personal communication, April 06, 2019). He continued, "…it is the constantly adding new things onto old things that kind of gets me like, 'What? Why can't we just do this?' [indicating how things were done before introducing a new concept]." Although Benjamin's grades in mathematics classes, including his scores on standardized tests, do not show a vulnerability in mathematics, he perceived learning mathematics as challenging, possibly as compared to the easiness with which he learned and performed in other subjects. Through the excerpt above he implicitly indicated that change

doesn't come easy for him. At times, Benjamin might get frustrated when new concepts and/or ways of looking at problems are introduced into the lesson.

Benjamin specified he does not see mathematics as instrumental for what he wants to do in life. "That's the thing," he expressed, "I don't know if most high school math is going to help me." He did show an understanding, however, that mathematics knowledge may help a person "secure a job in the future and be able to understand the job, if it has a lot to do with math." He saw a better connection between geometry and real-life situations. He felt that a person "can easily use those skills, like cosine, tangent, and all that." The following excerpt is suggestive of his thoughts regarding the usefulness of mathematics:

> Well, for a while, I had the firm belief that most math you learn in high school is actually useless but… yeah, it turns out that there are actually jobs for them so [laughing]… like, I mean, especially when it comes to stuff like geometry… geometry math it definitely helps when it comes to architecture, planning out housing, spacing, overall, if you need like…. Basically let's just say, you are planning a party, you have a room, you need to be able to fit all the items for the party in a room, you are gonna want to know the area and the perimeter of the room so that you are not like overstuffing the room and you cannot get anybody inside. (Benjamin, personal communication, April 19, 2019)

Unlike other subjects, he perceived mathematics content "building up" upon previous knowledge, increasing in difficult every day, and requiring the same repetitive work procedures. "It is still easy to do it just…" Benjamin confessed, "overall is just monotonous amount of work that just seems pointless to do over and over and over and over again" (Benjamin, personal communication, April 06, 2019).

Vulnerabilities in Learning Mathematics. Benjamin revealed that he struggled in middle school with "everything" related to mathematics, computation as well as reasoning. "Seventh grade was probably the worst," he confessed, "I had a 58 at the end of the first semester in that math class and then I got up to an 85 by the end of the second semester." When asked why he experienced challenges in learning mathematics, Benjamin expressed that he "just wasn't asking questions." He perceived, therefore, his lack of self-advocacy as a personal problem. "I wasn't very open," he stated, "and I am still not very open doing that all the time but back then I will not ask anything. I mean, I was silent most of the class period" (Benjamin, personal communication, April 19, 2019).

Benjamin also indicated that at times he gets frustrated and shuts down. This situation suggests Benjamin may have low tolerance to minor difficulties and/or setbacks when solving mathematical problems. "Mathematics uses numbers and equations and all that," he expressed, "and sometimes I cannot solve them so yeah, sometimes it gets frustrating, you know…" In another statement he indicated, "if sometimes I don't understand a subject, it's like, 'yeah, I am done. Ok. I'm just gonna go full on nothing at all. Ok." He elaborated,

> Yeah, I fully acknowledge that I've quit before in math and that is not helpful; I usually get back on it but… that definitely I think happened and that's kind of why the midterm didn't go so well… yeah, I remember that grade too well… (Benjamin, personal communication, April 19, 2019)

Benjamin indicated that a lack of classroom structure may negatively affect his learning and overall feelings of wellbeing. He was particularly critical about his peers from his Advanced Algebra classroom, their rough behavior, and lack of involvement in their learning. He perceived the classroom atmosphere as "hard to deal with." He specified that not everybody was bad, but

"there are some people in the class that are beyond help" (Benjamin, personal communication, April 19, 2019).

Another example of an unstructured environment that challenged Benjamin's learning was related to his teacher's instructional delivery. He explained an instance from his honors literature class where the teacher started the school year with a major project, without providing any scaffolding steps. In his view, the teacher gave no clear directions of how to accomplish the assignment. She handed them "a folder, a hanger, a paper clip, a couple of note cards, an envelope, and a bunch of random items" and presented "a one and a half – I counted the minutes and the seconds – a minute and a half long PowerPoint." Uncertain of what he was supposed to do with the items provided and how the final product should look, he perceived that he and his group of peers were "running around like headless chicken trying to figure out what to do with this thing – envelope folder thing" (Benjamin, personal communication, April 06, 2019).

Another vulnerability that Benjamin thinks he should work on is procrastination. In his opinion, he usually fails to progress because he is "procrastinating." Additionally, he thought he has challenges with his "mental math ability." He stated, "I still have to use fingers for addition" (Benjamin, personal communication, April 06, 2019).

Assets in Learning Mathematics. When asked what his strengths in learning mathematics are, Benjamin indicated he doesn't think he has any. "Usually when it comes to math," he expressed, "I am more, I would say… I don't know… I don't think a realist to be a personal strength cause usually when I am being a realist, I am being quite negative…" He perceived completing his work as a possible asset in learning mathematics. "I know I have been seen watching videos [on his personal phone] and stuff in class," he expressed, but I mean, I am still working" (Benjamin, personal communication, April 06, 2019).

Another asset that Benjamin indicated was perseverance, not specifically in mathematics, but in learning overall. "The only reason," he confessed, "I didn't mention perseverance earlier is because sometimes if I don't understand a subject… It's like, 'yeah, I am done. OK. I'm just gonna go full on [doing] nothing at all. Ok.'" Further he expressed that he improved in his ability to understand topics, and as such he considers that "it become more of a strength than a weakness at this point" (Benjamin, personal communication, April 19, 2019).

Perspectives Regarding Learning Differences. Benjamin was fully aware he was identified as having autism and expressed that he "could care less about what people think about that, honestly." During middle school, however, Benjamin indicated he tried to "make sure nobody knew" (i.e., other students) about his difficulties (Benjamin, personal communication, April 06, 2019).

Although Benjamin thought students "with an IEP" might need to be taught differently, he did not indicate learning differences as problematic. He was in general against a "standardized way of teaching students" regardless of whether a student has a disability or not. He expressed, "there's countless research that say that standardized teaching does not help students in the slightest, in fact that harms them more than help them." When asked to present a positive experience in mathematics, Benjamin talked about his class and teachers from 10th grade Geometry, which he enjoyed:

> I don't know [what made it so good]. Because Ms. Xan [the general education teacher of
> the Geometry class] seems different, she seems to teach math to where… cause I think
> most of the class was in an IEP situation so she taught most of the class the way that IEP
> students would be able to better learn the material. I don't know if most of the class was,
> I mean they might not have been, but I know a fair amount was because you know, we

had to go off in another room… So, I know a pretty good amount were actually IEP

[students] because a pretty good amount went in the other room to test with Ms. Yann

[the special education teacher in the Geometry class]. Ms. Yann was helpful because she

just… I don't know, Ms. Yann she just… she was willing to help everybody basically and

it was more like she didn't really, I don't know, give up on anybody. You [the insider

researcher] don't either, you don't, you really don't. Ms. Yann and you actually, both of

you, are really good because you don't give up on students. Ms. Xan didn't do it either, I

mean even when they were annoying and roughly, she still was most patient and

everything. That is what Ms. Zayn [the regular education teacher in the Advanced

Algebra class] isn't but this class is a lot harder to deal with [behaviorally] than the last

one. (Benjamin, personal communication, April 06, 2019)

Perspectives Regarding a Supportive Learning Environment. When asked what
supports he received in the mathematics classroom to aid his learning, Benjamin replied, "You
are sitting right here [addressing the inside researcher]." He affirmed,

Yeah, [it is] much easier to approach the teacher who was in the classroom for me and my

help than it is to just go to the main teacher which, I mean I can do that, it just is more

comfortable for me to talk to a teacher who is meant for me. (Benjamin, personal

communication, April 19, 2019)

Benjamin thought that a special education teacher present in the classroom helped him
"understand math easier" than if he was just trying to figure out how to solve problems by
himself wondering, "what the heck [is going on]?"

Caleb: Student with Autism

Background Information.

Favorite/Lest Favorite Class. When asked what his favorite class in school was, Caleb answered that it was history because he liked learning "about the world, like where we came from." His least favorite class was science. He took Zoology during spring semester of his junior year. Although he enjoyed learning "about animals and stuff" he found "things" getting "a little bit complicated." Caleb performed well in science classes despite admitting he did not like the subject.

Extracurricular Activities. As an extracurricular activity, Caleb was involved in the gaming club. Asked what kind of games he played, he answered, "all sorts of games really, yeah, like it is nice to just lay down the phone and just play a good card game" (Caleb, personal communication, April 26, 2019). The club members with their sponsoring teacher met every Friday after school. He was also part of school's select chorus group, A Capella (i.e., an ensemble made up of the top 12 women and 12 men of the school chorus program; an audition-only group; it met twice a week from 3:40 to 4:45) and performed in a theatre show at school. Although he enjoyed participating in clubs and hanging out with friends, he was not sure if he could attend in any of them as his mother had a busy schedule, working Mondays through Fridays, and his father was often on the road due to his work in commercial driving.

Every Saturday, Caleb was tutored in mathematics by his uncle. Probed further as of why he needed tutoring Caleb responded, "My parents want me to be ahead of the game." In addition, Caleb confessed that occasionally he heard discussions between his uncle and his parents in which the uncle "said something" about him "being naturally smart, smart like having higher IQ" (Caleb, personal communication, May 05, 2019).

Career Interest. As a career path, Caleb thought about becoming a teacher when he was young. His parents pushed him towards the medical field, but he was unsure about that especially since science was not his favorite subject. He would like to pursue computer science instead. He admitted being interested in learning how all the games that he is playing, even during class, on his phone or his Nintendo Switch worked:

> I want to learn the ins and outs of it like what makes them tick, you know. Like how… Like obviously most people are out there now but I… but since I always play on the phone, I play on my device I like wonder like… like how it is made… How it works, like how I can improve it? (Caleb, personal communication, April 26, 2019)

Perceived Connection of Interests and Mathematics. When asked if he saw a connection between what he learned in mathematics and computer science, as his main interest, Caleb mentioned the terms "binary" and "coding" and the process of problem solving in which "one wrong number" could make everything go "Kaput" (Caleb, personal communication, April 26, 2019). Although he was interested in a technical occupation, he did not get the chance to take any career tech classes related to engineering and computer science, not because he wouldn't have liked to do so but because he did not want to give up to his passion for music. "I also like singing," Caleb confessed, "so that's why I am in chorus classes as well."

Challenges in Learning Mathematics.

Perceptions about Learning Mathematics. Mathematics is Caleb's second favorite subject. He expressed joy in working through mathematics problems and being able to solve them:

> Math is fun. Like once you get the hang of certain aspects is a breeze! Like it's interesting. I am not sure how to put it in words. Like, I like it. I like math. I mean is

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going to be useful, is useful throughout all life. (Caleb, personal communication, April

26, 2019)

Caleb indicated he is not discouraged when solving mathematics problems. He stated that

when he remembers information he couldn't recall for a moment, it gives him a "rush of

adrenaline of some sort." When asked why he is not in a more advanced class (i.e., mathematics

offered in one semester as opposed to two semesters) he replied, "I tried going into the next, next

class but… himmm… seems a bit I should stay…" (Caleb, personal communication, May 03,

2019).

Within the mathematics high school curricula, Caleb expressed that he enjoyed 10th

grade Geometry and saw its connection to construction professions. His favorite part of

Geometry was related to problems involving sine, cosine, and tangent (i.e. trigonometric

functions). His least favorite part was "systems of equations" because sometimes they "can get

really complicated and you have to get like radical numbers…" (Caleb, personal communication,

May 03, 2019). He further voiced his dislike about seemingly complicated mathematics

problems through a visceral representation: "it just gets under my skin." In the excerpt below,

Caleb describes a situation in which mathematics can be challenging to him:

> And then there is… There is some of them have like… I've done like practice tests for
>
> SAT [Scholastic Achievement Test] and they don't let you use calculators for some of
>
> those sections, so it is even harder. Like I don't, I don't rely on the calculator too much
>
> but it's just crippling when it gets to… I use it most when I do systems of equations and
>
> it's just aaa... yeah… (Caleb, personal communication, May 03, 2019)

Vulnerabilities in Learning Mathematics. When asked about his struggles in learning

mathematics, Caleb specified he doesn't identify as having any major challenges. He further

continued, "is just like… like if there is something new it takes [me] a little time to learn it, like [I need] just a little help here and there." Indirectly, he indicated some memory difficulties. In his opinion, the teachers in the classroom facilitate students' recalling of information by promoting "certain things that help us remember." He would like to develop "better mental math." This suggests Caleb perceived this area to be a vulnerability. He stated, "I know like multiplication through memory for most of the numbers up to 10, then I have to count" (Caleb, personal communication, May 15, 2019).

Another vulnerability could be a lower level of tolerance to frustration. His visceral reactions to problems that pose him difficulties may be indicative of this problem. He used expressions like "it just gets under my skin" and "it's just crippling" to refer to his least favorite part of mathematics, namely systems of equations with irrational or complex solutions.

Assets in Learning Mathematics. Caleb did not mention any particular assets during the interviews. Identifying himself as "naturally smart" (Caleb, personal communication, April 26, 2019), however, can be considered a strength. In addition, Caleb finds joy (i.e., "math is fun") and is not deterred by minor setbacks or challenges in solving complex mathematics problems, which can be considered personal assets that help Caleb be successful.

Perceptions Regarding Learning Differences. Caleb described learning differences in terms of "those like tests in middle school, like you know, you take those tests to see what kind of learner are you, like visual learner, like auditory learner, that stuff and they say that I mostly learn through, like a mix of visual and auditory" (Caleb, personal communication, May 03, 2019).

When asked specifically about him being in special education services he specified that it bothered him when he was younger:

Like, like it was when I was getting older. I start feeling like I shouldn't be there like... I

could, I could do better than what I am, like better that what I was… (Caleb, personal

communication, May 03, 2019)

Caleb indicated that by 5th grade he felt he "got most of the help" he needed. When

asked what happened, Caleb voiced that "it was mostly like, I had an addiction." As he admitted,

he manifested a compulsive dependence to electronic use during classroom activities (Caleb,

personal communication, May 03, 2019). Caleb received "this little sheet like I did good," which

likely suggests a behavior intervention plan was in place to address his addiction to electronics.

As a reward for good behavior, he was allowed "to use the computer at the end of the day."

Although he continues to use his electronic devices during class, he felt that he has learned over

the years how to "multitask with it." When asked why he had this addiction he replied simply,

"it's just something that helps me get my mind off…" (Caleb, personal communication, May 03,

2019). Additionally, he uses his devices when he feels like he is done with the classwork and he

can than "take a break" (Caleb, personal communication, May 15, 2019).

Perceptions Regarding a Supportive Learning Environment. Caleb perceived having

two teachers in the classroom as helpful to students' learning. In his opinion, two teachers can

better attend to all students' needs:

Like when we have two teachers that can help… like if one, like if one can't answer, like

the other one can, or could, they can kind of help each other. (Caleb, personal

communication, May 03, 2019)

Caleb "cannot think of anything that needs to change now;" he finds the way

mathematics is taught in school as "perfect the way it is." In his opinion, anything related to

mathematics will help him in his chosen career path, computer science. Caleb's second drawing,

however, corroborates a preference for learning and engaging in mathematics work on the computer. "Since I want to go into the computer science filed," he stated, "I think that maybe we will be doing stuff on the computer." He was aware of the many resources available to striving learners such as videos and on-line methods of learning. Additionally, Caleb thinks that "most people are looking nowadays, for someone who can work in… that can work tech." He expressed that even his dad is of the same opinion, that when applying for a job, tech competency is what "most people are looking for" (Caleb, personal communication, May 15, 2019).

When asked what he would like to see changed, Caleb focused on the contextualization of mathematics education. He indicated that he would like to see more "hands on" type of work. For instance, referring to real-life applications problems, such as the amount a person has to pay over a number of years for buying a car with a certain initial cost and a certain interest rate, Caleb stated,

> Like aaa… Like aaa, when you are learning, do the notes first than aaa… like do the
> notes first then do a couple examples then like… like what the… like what Ms. Zayne
> [the general education teacher in the classroom] has been doing for the last couple [of
> days] … with like the compound interest thing. (Caleb, personal communication, May 15,
> 2019)

Daniel: Student with Attention Deficit Hyperactive Disorder

Background Information.

Favorite/Least Favorite Class. Daniel's favorite class was Video-production. He planned to continue with this concentration path. His least favorite class was mathematics. "Well," he expressed, "it just runs in my family, we just don't like math." Probing further as to why he and

his family did not like mathematics he replied, "we are not terrible, but we are just a little slower at it than most people." He was surprised his mother chose as a profession accounting, a mathematics related career, since she disliked mathematics.

Extracurricular Activities. Daniel earned his Eagle Scout badge his junior high-school year. He also joined the Video-production club which met every Tuesday and Thursday morning. He saw a connection between mathematics and his audio and film work, not just regarding computation but problem solving as well. He stated that they have to "know certain feet away that the actors have to be to shoot" and "you have to like kind of plot where we're filming and know all destinations." Daniel appreciated the connection and positivity that the club brought to his life. "Just the people there," he shared, "they are really nice and generous" (Daniel, personal communication, April 09, 2019). In addition, Daniel could see how mathematics was used in both his extracurricular activities. He had to build a flower bed and a bench for a local elementary school as part of his Eagle Scout project. In addition, he perceived he used a lot of mathematics concepts in his Video-production activity for "mapping out the places that we will shot out" for example, or in editing actions:

> When we were editing, we have some sort of math system set up to where we have to
>
> like… put things in places they are supposed to be there, and we have to learn how to use
>
> decimals, and fractions and condense it all around the screen. (Daniel, personal
>
> communication, April 10, 2019)

Career Interests. At the time of the study, Daniel expressed he would like to pursue a career in Video-production industry, "cause I have been into acting and all that" he stated (Daniel, personal communication, April 09, 2019) and felt comfortable being in front of the

camera. He was also thinking about becoming a firefighter because he liked to help people. He took JROTC classes that can benefit him with this career path.

Perceived Connection of Interests and Mathematics. Daniel expressed a link between his work in both boy scouts and Video-production, and mathematics. "Cause we have to know certain feet away that the actors have to be to shoot," he indicated, and "you have to like kind of plot where we're filming and know all destinations" (Daniel, personal communication, April 09, 2019). Additionally, he understood that without mathematics, the work he does in Video-production would not be possible. In another passage he described his work as follows:

> When we were editing, we have some sort of math system set up to where we have to like… put things in places they are supposed to be there, and we have to learn how to use decimals, and fractions and condense it all around the screen. (Daniel, personal communication, April 10, 2019)

Further probed as to why he was not motivated to become more proficient in his mathematics class, since he understood the link between Video-production and mathematics, Daniel indicated, "cause I'm just now starting to get into it" (Daniel's biographical interview).

Challenges in Learning Mathematics.

Perceptions about Learning Mathematics. Daniel's experiences with mathematics were, as he put it, "decent." He explained, "cause I've always had another teacher in there." Daniel indicated that he got the help he needed in the mathematics classroom even when he was younger based on the presence of an extra teacher in the classroom. When asked in what way two teachers helped his learning, he replied, "cause one will show me one way and the other one will like, have another way as well and I just usually pick which one is the easier way" (Daniel, personal communication, April 10, 2019).

When describing what helped him in learning mathematics he stated, "I mean just not wanting to be able to work at like a terrible place when I will be done with high school." Daniel's motivation for doing work in mathematics, therefore, was avoidance of a bleak future at a job that he will likely not enjoy. His statement shows an assumed connection between mathematics knowledge and a career that is not "terrible."

Although mathematics is his least favorite subject, Daniel sees value in it. He admits that knowing mathematics helps him perform well in his preferred activities and in life, in general. He expressed, "I really think that mathematics is pretty much for a lot of stuff in life" (Daniel, personal communication, April 10, 2019).

Vulnerabilities in Learning Mathematics. Mathematics as a field represents a challenge for Daniel. He expressed, "It's just… it's a little… it takes me, you know… like… kind of know what I am doing." Daniel, however, showed that he was aware of the demands of mathematics class and how to meet them, specifically, through "practice" (Daniel, personal communication, April 09, 2019). In the excerpt below, Daniel expressed in what way he is experiencing difficulties, in particular when learning Advanced Algebra:

> I am just… It is kind of hard for me because whenever I take algebra classes is just like numbers here and here and here and here, that's like you have to do all different functions with all those numbers, it just gets confusing at times. (Daniel, personal communication, April 10, 2019)

During the focus group interview he expressed, "I am not sure why, I am just one of those people that like in a group, like if I see anybody else not doing something, I just, you know… just my mind set is just going straight to what everybody else is doing" (Daniel, personal

communication, May 17, 2019). Daniel therefore cannot seem to ignore the influence of his peers.

Assets in Learning Mathematics. Daniel did not talk about assets at all, but he referenced them indirectly. When asked about mathematics in general, he answered by giving instances related to the work he does in Video-production. In relation to perceived strengths that can help him become successful, he expressed,

> Just being able to like, know, 'Ok we are supposed to be doing this, this, and this' and… back to the audio and film situation you have to know where numbers go and then certain fractions and decimals. (Daniel, personal communication, April 10, 2019)

In the passage above, Daniel indirectly indicated that he has a good ability to solve mathematics problems when applied to a context, such as appropriate distances for camera placement while filming. In other words, he learned by experimenting and manipulating a real-life situation directly:

> And we use [showing on the computer screen] that on here because we pull, and we use, for example… this out here, will pull certain shapes; for example, we can put a square if we go and do that; we do a circle like a moon or something and all that. We take the shapes and we put them in, you know, there is like a category right here up to the side and that's all about just that one shape. And it's like positions, and certain angles and all that and it's like you have to put the right angle, you move it to whatever you want to but as you move it, the coordinates and everything else changes with it. (Daniel, personal communication, April 10, 2019)

Another important quality that is often overlooked by the educational system and frequently passes unnoticed as a measure of success, was his desire to help others.

Perspectives Regarding Learning Differences. When asked if he thought he learned differently from other students, Daniel replied, "Honestly, I think that everyone learns differently." He does not appear to perceive himself as being different. "I mean," he stated, "we all have our differences." In general, he perceived he was fulfilling all the course expectations in order to pass the class. When asked how he learns, Daniel expressed,

> Ammm… just watching what you guys are doing, just putting on my paper, just making sure I am putting everything correctly and asking questions if needed. (Daniel, personal communication, April 10, 2019)

Another learning and/or practice strategy that helped Daniel learn was to "draw visually like." "I draw stuff," he expressed, "on the side of a piece of paper and notes and all that." Daniel, hence, processed what he learned when and while drawing by making a visual connection to the concepts he tried to understand.

Perspectives Regarding a Supportive Learning Environment. Besides having two teachers in the classroom, Daniel could not think of any other support that he might need. When asked what might help him earn higher grades in class he answered, "I don't know." Further probed if he could think of anything else that could help him become successful, he replied,

> Nothing, I think, cause, I mean, I am not going be a major in it or anything but as long as people that are very high up there know what they are doing with math, and passing it down for us to learn, I am fine. (Daniel, personal communication, April 10, 2019)

Summary of Interview Data

Table 3 shows a synopsis of each students' background information and distinguishing preferences, perceptions, and/or beliefs resulting from biographical, open-ended, informal conversational, and focus group interviews.

Table 3

Synopsis of Students' Perceptions

Name / Category	Armando	Benjamin	Caleb	Daniel
Exceptionality	English Language Learner (ELL) & Learning Disability (LD)	Autism Spectrum Disorder (ASD) & Gifted	Autism Spectrum Disorder (ASD)	Attention Deficit Hyperactive Disorder (ADHD)
Preferred class	Mathematics	History	History and mathematics	Video-production
Least preferred class	Zoology	Mathematics	Zoology	Mathematics
Extracurricular activities	A member of the Video-production club and of the Architecture, Construction, and Engineering (ACE) program	Year-long swimming (in school and out-of-school participation)	A Capella and Gaming club	Eagle scout and a member of the Video-production club
Career interests	Architecture / project manager	Secondary education / political science	Computer science	Video-production / fire fighter
Expectations for post-secondary education	Community college	A four-year college	A four-year college	Certification / attend fire fighter training
Perceptions about learning mathematics	Perceived he grew a lot personally and academically during the current year. Did struggle in the past.	Found mathematics not useful for his own career. Struggled in middle school.	Enjoyed working on mathematic problems.	Perceived his experience with mathematics was decent because he always had two teachers in the class. Struggled through all school years.
Perceived link between mathematics and real-life	Mathematics did relate to his extracurricular activities and his career interests.	Mathematics did not relate to his extracurricular activities or career interests, but he saw it as helpful for certain professions.	Mathematics did not relate to his extracurricular activities. It related to his career interest.	Mathematics did relate to his extracurricular activities but not with his career interests. Daniel understood that without math, his choices in life are limited.
Perceived vulnerabilities	▪ memory ▪ need for re-explaining when new concepts are introduced ▪ difficulty transferring concepts to new situations ▪ confused by word problems and/or or worded directions	▪ tolerance to frustration ▪ processing speed (in comparison to the speed for other subjects) ▪ tends to quit when encountering difficulties ▪ number sense (mental math) ▪ negative outlook towards the subject matter	▪ tolerance to frustration ▪ processing speed (in comparison to the speed for other subjects) ▪ memory ▪ number sense (mental math) ▪ excessive use of electronic devices during class	▪ distractibility ▪ difficulty using and understanding the use of numbers out of context ▪ imitation of peers' behaviors (i.e., playing on personal devices; not doing their work) ▪ processing speed ▪ negative outlook towards the subject matter
Perceived assets	▪ listening ▪ paying attention ▪ completing the work in a timely manner ▪ working and learning cooperatively ▪ current positive outlook towards the subject matter	▪ being a realist ▪ working and learning independently ▪ completing the work ▪ perseverance (albeit not in mathematics)	▪ being "naturally smart" ▪ working and learning independently ▪ positive outlook towards the subject matter	▪ good at applying math concepts to real-life situation (e.g.: in the Video-production club). ▪ a desire to help others learn ▪ working and learning cooperatively
Perspective on learning differences	None distinguished. The learning and/or practice strategy that worked best for Armando was personal assistance from the special education teacher in the classroom and teamwork.	None distinguished. Benjamin indicated he needed assistance from the special education teacher.	None distinguished. Caleb found helpful to have two teachers in the classroom. Caleb might need differentiation strategies that support his perceived memory difficulties.	All students learn differently. The learning strategy that worked best for Daniel was watching the methods of both teachers in the classroom and choosing what fit him best and

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				when making visual representations.
Perspective on disability	Everybody has them / Nobody is perfect / Not perceived as a problem	Comfortable with it / Not perceived as a problem	Comfortable with it / Not perceived as a problem	Comfortable with it / Not perceived as a problem
Perceived support in the classroom	A special education teacher made a difference in Armando's personal and academic growth in learning mathematics.	The special education teacher is specifically assigned in the classroom for Benjamin and his needs; he finds her easier to approach.	Teachers in general use differentiation strategies that help Caleb learn.	Both teachers in the mathematics classroom use differentiation strategies from which Daniel adopts what fits him best.

Drawings Analysis

Vygotsky (1978) saw drawings as pictorial language that allows children to ponder and find visual ways to represent their thoughts, much like a form of speech. As Haney et al. (2004) document, "despite the century-old tradition of using children's drawings in psychological research, very little educational research, other than that focused on art education, has employed drawings" (p. 248). In their view,

Student drawings provide a rich opportunity to document students' perspectives and to transcend assumptions and artifice regarding what is going on in classrooms. Yet though literature on children's drawings has accumulated in the fields of clinical psychology, art education, and child development, drawings have been largely neglected as a tool of educational research. (p. 267)

Current studies using visual representations as a method of data collection and analysis focus on pre-service teacher candidates or practitioner teachers (Akerson, 2017; Bessette & Paris, 2016) as well as on elementary and middle school students (Cerney et al., 2007; Einarsdottir et al., 2009). Little research is available on the views of high schoolers. As Haney et al. (2004) affirm, pictograms represent "an alternative method to document the lives of schools, classrooms, and students by drawing, quite literally, on the insights and perspectives of those who are perhaps the most assiduous observers of school and classroom life, namely, students" (p. 243). To understand the views and perspectives of secondary students with disabilities, therefore,

a plunge into their thoughts and emotions as it relates to learning mathematics, was in order. Evidence from the analysis of students' pictograms might be hard to capture through other methods of data collection. In addition, the results gathered through illustrations can complement and reinforce the answers gathered through other data collection methods typically employed in qualitative research (i.e., interviews, focus group sessions, or document reviews) serving as a fidelity device. As Haney et al. (2004) uphold, "drawings offer a different glimpse into human sense making than written or spoken texts do because they can express that which is not easily put into words: the ineffable, the elusive, the not-yet-thought-through, the subconscious" (p. 241).

In the current study, drawings were used "in conjunction with other methods of inquiry to attain a richer picture" (Bessette & Paris, 2016, p. 80) of how students perceive learning mathematics, their mathematics classroom, and an environment supportive of their needs. Accordingly, the second part of chapter four covers the apparent features and characteristics of the visual representations provided by the participants in response to two prompts. In the first illustration, they were asked to draw a picture depicting how they see themselves in the mathematics classroom. The second prompt instructed them to draw a classroom in which they are provided with all the resources they think would help them learn and become successful mathematics learners. Students' clarification of their illustrations gathered through informal conversational interviews added "meaning behind individual drawings" and served as a validity device against incorrect interpretations (Haney et al., 2004, p. 251).

Students' Representations for the First Prompt

The purpose of the first prompt was to gain information about how students perceive themselves in the mathematics classroom. The prompt stated, "Think about the kinds of work

and activities you engage in within our mathematics classroom. Draw a picture of how a camera would see you when you are learning mathematics in your mathematics classroom."

Armando's Drawing for the First Prompt. Armando's illustration shows his preferred way of being and learning. He turned in two sketches for the first prompt (see Appendix B and C). In the first one, Armando represented himself with a smiling face, larger in comparison to his colleagues in the classroom. His peers appear to be chatting something not relevant to the mathematics lesson, suggested by erratic lines inside speech balloons. "Those are my teammates," Armando indicated. He continued, "right here I basically drew myself a lot bigger, you know, than the other ones [peers]" (Armando, personal communication, April 12, 2019).

When asked why he represented himself larger than his peers he answered, "because I feel like, I'm like, I have succeeded in math, I feel, I feel more comfortable now, this year." Armando stated he felt he grew marginally more than his peers because he was "listening" as opposed to "talking a lot" [as his classmates do]. Drawing himself in a social context points out that to Armando, relationships are important. In his visual representation to the first prompt he also traced his evolution in learning mathematics throughout the years. He indicated his transition from struggling in 9th and 10th grade, barely passing with a C (as the paper in his hand shows), to feeling proud and confident in his personal growth and achievement in 11th grade, as he received an A+ on an assignment. In the dialogue bubble under 11th grade, he represented different mathematical operations, denoting he became comfortable with the subject matter. As he explained the details in his drawing, Armando stated,

> Yes, in 9th grade, yeah. Freshmen year I started off a little bit aaa… I started a little bit
> bad, you know, I did aaa… I was on the borderline of like, of, of C, C, and a B and I was
> just like aaa… I was just like frustrated a little bit. And then 10th grade too. Like a little

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bit in 10th grade. Like I started like aaa… aaa… you know cause math, math for me

wasn't really that good, you know, I feel like they [the main and special education

teachers in the classroom] weren't like helping me. In the 10th grade they were, you

know, a teacher was actually there [to help me] but like aaa… I just feel 11th grade like,

this is actually the first time like, I don't know, I, I'm having like good grades in that

class, in math. (Armando, personal communication, April 12, 2019)

In the second illustration for the first prompt, he represented himself and the teacher

[special education teacher] as she verbally encourages him. Armando might be suggesting that

his teacher's empowerment has contributed to his growth in this drawing. In the speech balloon

above the two characters, he listed the statements that motivated him succeed in the class:

You can do this! Don't let anybody ruin your dreams! Pursue your dream! Don't fall!

Keep going! You're right! You're not wrong! It makes me [the teacher] happy to help

you! (Armando, personal communication, April 12, 2019)

Benjamin's Drawing for the First Prompt. Benjamin drew a view of the classroom

from his desk, disclosing a preference for independent work (see Appendix I). His drawing is

very detailed, showing exactly what he was doing at a moment from his workday, what was on

his desk, and what was on the white board. Benjamin's drawing covered the entire page,

representing the physical environment accurately. He did not, however, represent any human

beings, not even himself.

In the front is the white board; a problem is written with the information that students are

supposed to jot down in turn, on their paper. It looks like a modeled example as Benjamin

included the same equation on the paper entitled "NOTES ON LOGARIMS [*sic*]" from his desk

(i.e., it represents the characteristics of the same logarithmic equation and graph). On his paper,

he listed the title, his name, the date (4/22/19), the block period (2nd), and parts of a worked example of a logarithm problem from the board. On the left of the board is seen part of the Smart Board (interactive white board) which has the word SMRT on it and on the right, additional proceedings that the teacher posts to inform students what to expect during the lesson. He wrote "opener" at the top, consisting of a "warm-up", followed by "middle", including "notes" and "practice", and ending with "TOD" (ticket out the door). From the positioning of the Smart Board, which is situated in the middle of the wall from the front of students, Benjamin is positioned on the right side of the class, second row.

On the desk, besides the main paper on which he is taking notes are placed a water bottle (DASANI brand), his phone, and on the left, a smaller paper with the title "Logarithms", likely representing the classwork that he would have to complete after taking notes. In a larger scale considering the proportion to everything else he drew, lays his pencil. The sketch follows drawing rules of perspective creating the illusion of distance between his desk and the board.

Benjamin depicted with accuracy what was in front of him as if he had taken a picture of an exact learning moment. Yet, everything looks static as if all students and teachers are absent around him. Interestingly, he appears ghost-like, witnessing from his seat how the objects around him are situated. His drawing depicts in detail the classroom environment and the main teacher's lesson structure and habits in the classroom as well as what is important to him (i.e., the water, the phone, taking accurate notes, and his pencil) and his own actions (i.e., taking notes, preparing for practice).

Caleb's Drawing for the First Prompt. Like Benjamin, Caleb drew himself at a desk, completing an assignment, showing his preference for independent work. His drawing is not detailed but rather just a rough sketch. He confessed that he does not "really have an artist's

touch." He and the desk are situated in the middle-upper part of the page. "I mostly just write."

he explained his depiction of himself on the paper, "like writing down on the… on the work…

like the work down just like any other class, really" (Caleb, personal communication, May 15,

2019). Besides this small representation of him in the mathematics classroom as a stick figure,

the sheet is completely blank, leaving the appearance of a small dot in a wide universe.

In the drawing, Caleb is seen at the desk with a paper in front of him. He appears to be

attentive and content or smiling pointing to, perhaps, the enjoyment he feels when he works

mathematics problems, as indicated in his interview (i.e., "math is fun"; (Caleb, personal

communication, May 03, 2019). He holds a pencil in his hand, drawn in a larger scale than the

paper, the desk, and him. The view appears to be from above.

Daniel's Drawing for the First Prompt. Daniel misread or misunderstood the first

prompt and ended up drawing three visual representations instead of one (see Appendix N, O,

and P). In the first drawing for the first prompt, Daniel depicted how mathematics is used in the

Video-production activity pointing to his preferred way of learning namely, in context. The

drawing is detailed, depicting a shooting scene. Important measurements are included such as the

distance between the camera and the main character, his shadow, and further to a Godzilla type

of creature, that spits fire. He looks at the scene from the side. The scene he portrayed is vivid,

allowing the viewer to virtually see and feel the movement and excitement of the characters. The

sun, the fire of the dragon/dinosaur, the light of the camera, the vibrant impression of movement

makes his representation appear bright. He explained,

> So, what I did is a normal audio and film classroom and what we do is on days that we
>
> are shooting films, where… we have to use math to how far away the actors are, how big

their shadows are, the distance from one thing to another thing, how tall the shiny pieces

are gonna be… (Daniel, personal communication, May 15, 2019)

In a second drawing, Daniel looks inside his brain and reveals what is important to him:

sports, eating, gaming, work, and the phone. Smaller in size, among the five main essential

activities in his life, appears a thought bubble for mathematics. Each image is detailed. In one

bubble appears the controller of a gaming console and the phone with all buttons on them. In

another bubble he indicated he works at a store. In another one, he represented himself in

movement playing basketball. In the last bubble he displayed what type of foods he craved for.

Finally, by the third drawing he read and understood the directions of the prompt and

generated a drawing that shows how the mathematics classroom looked to him. The general

mathematics teacher is placed to the right of the board, apparently addressing the lesson, with a

student standing by her. She looks upset or annoyed. The special education teacher appears on

the left, "watching over the class, making sure that they [students] are doing what they are

supposed to be doing" (Daniel, personal communication, May 15, 2019).

Some students, perceived by Daniel as "a distraction in the class", are drawn in detail,

including something characteristic of their everyday utterances and/or actions. For example, the

character on the right of the page is often addressed by peers as, "quiet bones" which means "just

be quiet," specified Daniel, "and they call him bones" because he is skinny. One student, as

Daniel sees it, "is always bothering Ms. Zayn. [the general education teacher]. He is placed to

her left side, calling constantly for her attention while she tries to teach, "Mrs. Zayn, Mrs. Zayn."

To another student she tells repeatedly, "That's wrong, Andrew" [his work and/or his answers to

the problems from the page he holds]. One student is at the board, showing an example of a

problem. On another part of the board is written "Quiz tomorrow," letting students know what to

expect and prepare for. Daniel depicted himself in a small scale, on the left side of the classroom,

sitting at his desk and watching everything going on in the class as if it were a show. He stated,

"I see myself quiet sometimes, but like talkative most times…" (Daniel, personal

communication, May 15, 2019). He took an aerial snapshot of the environment, looking at the

class from an angle above.

The three drawings highlight Daniel's acuity of perception and creativity of his mind. His

attention appears divided among different details from his context – from the actions of his peers

and teachers to his inner desires and thoughts. A split of attention on many concurrent external

and internal stimuli might denote difficulties focusing on the lesson or the task at hand.

Summary of Participants' Drawings for the First Prompt. The table below show

categories that emerged from the analysis of participants' drawings to the first prompt.

Table 4

Categories depicted as a result of first drawing prompt.

Name / Category	Armando	Benjamin	Caleb	Daniel
Preferred way of learning	Collaborative	Individual	Individual	Individual / Collaborative
General mood of the drawing(s)	Positive / in movement	Neutral / static	Neutral / static	Positive / in movement
Self-representation	Bigger in comparison to others	None	Small / alone	Small in comparison with others
Peer representation	A few students represented	None	None	A few students represented
Teacher representations	The special education teacher was represented	None	None	Both, general and special education teachers represented
Mathematical details used in the drawing	Some	A lot	None	Some
Classroom details	None	A lot	None	A lot

Students' Representations for the Second Prompt

The second prompt required students to conceptualize and draw what they might require

to facilitate their mathematics learning. It asked students, "Think about the kinds of support that

you need to be successful in learning mathematics. Draw a picture about an imaginary classroom in which you are provided unlimited resources that would help you learn."

Armando's drawing for the second prompt. Armando drew four groups or stations of four students working together. Each student has a paper in front of him/her. The drawing is minimalistic, presenting no additional writing or other information. It appears to depict one single idea – work and achievement as a group/team. As he expressed, "it's [learning and working] not all about solving problems, you know, it's about, you know, working with others." Armando repeated this belief, of success as a group/team, throughout his interviews. For example, he talked about how people can succeed in their endeavors by illustrating how he and his peers work together in the Video-production club. "We don't do only like math," Armando explained, "solving problems, but we work with others, you know… we respect each other, that's how we are going to succeed, you know, by communicating, you know, with others" (Armando, personal communication, March 27, 2019).

When asked what he represented in his drawing, Armando voiced that to him personally "working in groups, working with each other" is vital as students can ask each other questions and can help each other "a little bit more" in order to learn the material and succeed (Armando, personal communication, April 12, 2019).

Benjamin's drawing for the second prompt. Benjamin elaborated in detail how he imagines a supportive classroom, with unlimited resources. In his second drawing, Benjamin wrote labels pointing to elements from his drawing. He wrote: a) at the top of the page "Smartboard for lessons"; b) at the bottom of the page, "emphasis on ONLINE and IN CLASS" (and placed in parenthesis homework seldom/little) and "Groupwork stations with Teacher / without other students;" and c) on the left margins of the page, "Computers for unlimited access

to info," "Electronic classroom' idea, all resources in class and online;" and "Laptops for groupwork online" (the words that he capitalized appear as such). Benjamin sees, thus, the optimal class for students' success being fully digitized. In regard to technology lagging in schools in comparison to what is available on the market he stated, "classes should update to 21st century" and use "internet application" because "they already exist." "I feel," he continued, "it would be a lot easier for people to use the technology that they have access to, or they should have access to, to learn the material" (Benjamin, personal communication, May 08, 2019). Benjamin voiced,

> Instead [of using the technology] we are restricting what is available and we… it's obviously… we obviously know why we are restricting what is available [referring to Internet usage for other purposes than school related such as watching videos or playing games], so keep those restrictions going but, I'd say make technology more widely available to the student body of the school system. (Benjamin, personal communication, May 08, 2019)

When asked how the content of the lessons should look, he replied that it should make students "stimulated" and "interested in learning." He further exposed that lessons should have "real applications" and "relate to real life and how people would use it in their future otherwise," in his opinion, "people won't want to learn." Benjamin emphasized the idea that students "need to see how the information taught applies to their life and their future" and "stuff that has no applicable use should be scrapped."

When further probed on the topic of how teachers can differentiate mathematics to match students' interests and learning preferences, Benjamin elaborated, "basic math you have to learn every day but other than that you could learn specified information." When asked what he means

by "specified information," Benjamin talked about "applied mathematics" to a field of interest, specifically learning mathematics in the context of marketing, accounting, engineering, nursing, etc. To him, "every bit of it [specified information] should be on-line applications created by the school board and the school system" while basic math "can be a mixed of on-line and paper resources." Benjamin was an advocate for the school system to "encourage technology to become a part of the learning process over pushing it away" (Benjamin, personal communication, May 08, 2019).

Caleb's Drawing for the Second Prompt. Through his second illustration, Caleb indicated his preference for learning using computer tutorials and applications. For him, learning mathematics using technology in the classroom has significance for his future career. He stated, "since I want to go into computer science, I think that maybe we will be doing stuff on the computer" (Caleb, personal communication, May 15, 2019). Accordingly, Caleb depicted himself at a desk, working at a computer.

As in his first drawing, Caleb's sketched a minimal, stick like outline of himself, with the desk and the computer in front of him. Again, his representation is small, placed toward the upper middle part of the page, leaving bare the rest. As such, the emptiness of the page appears vast in comparison to the drawing in itself which is miniature and minimalistic. Caleb, therefore, would like to see more technology to stimulate learning:

> I mean since that's what most people are looking for nowadays, someone who can work in… that can work tech. Even my dad said that everybody is trying to find jobs and that's what most people are looking for [computer proficiency] … (Caleb, personal communication, May 15, 2019)

Daniel's Drawing for the Second Prompt. Armando, Benjamin, and Caleb portrayed an educational environment supportive of their needs and learning preferences that should already be in place because the resources are available (i.e., learning through technology applications and group work). Unlike them, Daniel projected education in a faraway future. In his drawing, the classroom appears hidden in a "giant spaceship" flying among planets and stars. He explained,

> So, I believe that in the future we will be colonizing a lot of other planets. So, see, you got all these planets and all that… they got like little houses and buildings on it, you get to ride in spaceships… (Daniel, personal communication, May 15, 2019)

He wrote numbers in his sketch designating distances and speed, which indicate the idea of working out on problems directly related to real-life applications (i.e., given the distance x and the speed y, how much time it will take us to get to planet z?). He named this type of learning "Colonization & Exploration." The idea of "exploration" suggests Daniel's learning preference. For example, he finds helpful having two teachers in the classroom presenting differentiated methods to solve problems because it allows him "to explore" what works best for him (Daniel, personal communication, April 10, 2019).

Also, in explaining how he learns, Daniel talked about making drawings on the margins of the page, which represent the inner thought "exploration" he uses to work through problems. (Daniel, personal communication, May 15, 2019).

As in his previous rendering, his drawing in response to the second prompt is filled with details. The planets and the spacecrafts appear in movement, each with its own spin and direction, pointing again to Daniel's vivacity and complexity of imagination and attention to details.

Summary of Participants' Second Drawing. The table below shows additional categories that emerged from the analysis of the second drawings.

Table 5

*Categories depicted as result of second drawing prompt*

Name / Category	Armando	Benjamin	Caleb	Daniel
Preferred way of learning	Collaborative	Individual	Individual	Collaborative
Imagined supportive environment	Learning in groups	Learning through technology	Learning through technology	Learning through exploring in the real world
Imagined educational environment	Should be in place	Should be in place	Should be in place	Does not yet exist

Cross-Case Results

The purpose of employing a cross-case analysis was to compare the perspectives and context of all participants and identifying – through intuiting and critical reflection – categories of significant statements that were common and those that were different among them (Ayres, Kavanaugh, & Knafl, 2003). While analyzing the data from in-depth biographical, open-ended, informal conversational, and focus group interviews, participant-generated visual representations, document reviews, and researcher-generated memos, four general themes emerged. They are respectively: 1) insights on supports to students' learning; 2) perceptions of mathematics learning; 3) assessment of mathematics education; and 4) views on the use of digital devices in the classroom. Each broad category has several subthemes. They are summarized in the figure below.

Figure 5

Themes and subthemes that emerged from data
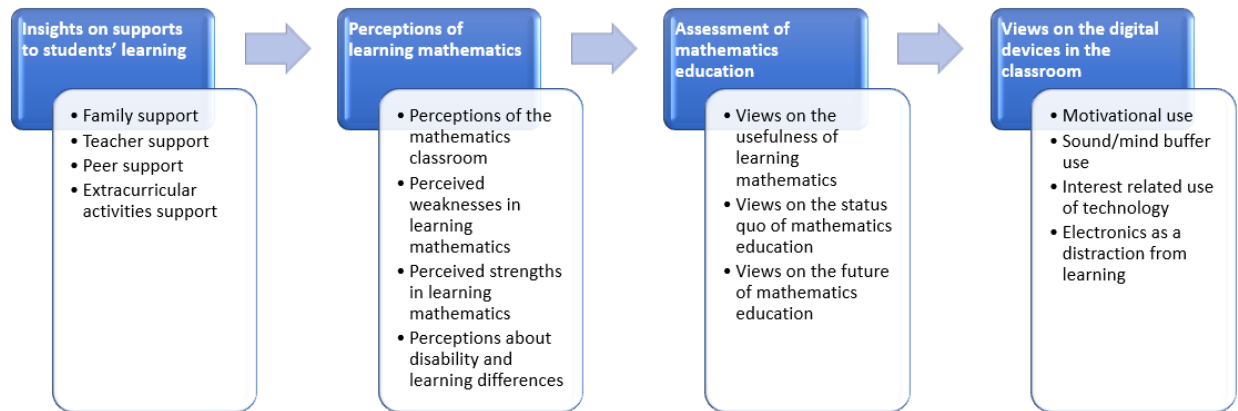
In finding the themes I followed three processes that occurred concurrently, namely data reduction, data display, and conclusion drawing as recommended by Miles and Huberman's (1994) systematic approach known as thematic analysis model. The data collection took 3 months (i.e., during Spring semester of 2019) and the data analysis took an additional 3 months (i.e., during the Fall semester of 2019). Finding the themes was an iterative process heavily based on repetitive reading of transcripts, writing notations, checking data relevance and correspondence across participants, and organizing the information into tables and figures. In other words, the themes were identified through evaluating the raw data repeatedly as a method of researcher triangulation.

I worked systematically (Creswell, 2013) through the data in order to identify codes. In the first stage of data reduction, I read the raw data (i.e., transcripts, drawings, documents) and started the first coding for building an in-depth portrait of each student independently. I re-read the data and compared the codes for similarities and differences for each student and adjusted them until a logical structure of codes was equivalent across all participants, which I further organized in tables and figures.

I split the data in two groupings. One contained contextual and case description collected through in-depth biographical interviews, to which I added document review data. Contextual data for each student (i.e., exceptionality, race, or family data) was used to present a portrait of each student in the methodology chapter of the study. The second grouping was applied to write the within-case results from information gathered through in-depth biographical, open-ended, informal conversational, and focus group interviews. The within-case results comprised additional background information that embodied students' views (i.e., favorite/least favorite class, extracurricular activities, career interests, and perceptions of interests to mathematics) to which I added student perceptions/perspectives on each distinguished code. Those matched the questions that elicited students' answers (e.g., if the question asked about extracurricular activities, I made a code for "extracurricular activities"). Each word/sentence(s)/paragraph was flagged for one or multiple codes. The visual representations were analyzed separately and represented a triangulation method to verify the codes that resulted from analyzing students' interviews.

While reflecting and writing the within-case results, patterns started to emerge as a repeated way in which all participants expressed their perspectives. All students talked about supports for example, all students shared how they felt about mathematics, and all students described their experiences in the mathematics classroom. I organized the data around those observed patterns in tables and figures (i.e., researcher's memos). From the observed patterns, I wrote the themes (second coding) for cross-case analysis. I used inductive analysis to find the patterns and subsequently the themes. Because family seemed an important descriptor for each student, for example, I re-read the transcripts and highlighted the sentences/paragraph that talked about family explicitly or implicitly and wrote besides it, linking it with an arrow, "family

support." Students talked about other forms of assistance, in particular about support received from teachers, peers, and extra-curricular activities. I collapsed all support groupings into a general theme and named it "supports to students' learning." Each form of support became a subtheme.

The questions that I asked myself and recorded in researcher's memos as I was reading through data to identify patterns and meanings were: "What does the data (words, sentences, paragraphs) convey?", "Do all students talk about those aspects?", "Does the data relate to my research questions?", "In what way it relates to my inquiry?", and "To what aspect of my research questions it relates?" While creating figures and flow charts with the themes and subthemes I was able to refine and adjust them and also to distinguish similarities and differences among cases. Next, I validated the accuracy of my findings through deductive analysis through re-addressing the literature review. The questions that I asked were: "Do I see a connection between the themes I found in the data and the literature review?", "If yes, in what way?", "If no, why it might be so?", and "What is similar and what is different in students' answers from the literature review?" I eliminated what appeared to be redundant and refined the names and explanations of the themes to best represent participants' perspectives. Each theme captured and unified students' views into meaningful pieces of evidence from numerous text segments.

During the following phase of the analysis I determined what aspects of the data was captured best by each theme. This process occurred till all sections of text relevant to the research questions were included. The themes were organized and reorganized until all relevant text explained each theme, and all data was represented and displayed in a meaningful manner. Direct quotes were used to write and support each theme and subtheme. Finally, the literature

was used to support the patterns and themes found in the study, to contradict, or add to the body of knowledge regarding students' perspectives on learning mathematics at the secondary level.

Participants' Insights on Supports to Their Learning

Secondary students with disabilities presented five relevant aspects of learning that have direct socio-cultural-historical roots, namely: a) family support; b) teacher support; c) peer support; and d) support from extracurricular activities.

Family support. Directly or indirectly the family as a system of social, motivational, and academic support in students' success was apparent in each participant's narrative as previously documented (Groves & Welsh, 2010). Caleb's account is representative in showing the impact of family on students' growth and achievement. Caleb's family involvement in his schooling and their positive outlook of what he is and can do was evident in shared opinions during domestic discussions of him being "naturally smart", in their advice to pursue a career in the medical field, and in offering him tutoring every Saturday in order to "be ahead of the game." Despite a busy schedule as a mother of three and a nurse, Caleb's mother made time to get him to and from his extracurricular activities. Talking about participating in the select A Cappella choir group, for example, Caleb specified, "Like I wasn't sure if I can go because… like on Mondays through Fridays my mom goes to work," indicating the effort his mother set forth in order to accommodate Caleb's after school activities (Caleb, personal communication, April 26, 2019).

Benjamin mentioned his parents' high expectations of his learning and performance in school. He maintained, "Hey, I have mostly Bs [in mathematics class] which is not that bad actually but for my family that's… for my family that's death how B is not A, seriously!" (Benjamin, personal communication, May 17, 2019). This statement suggests that Benjamin is encouraged consistently to aim high and that his parents believe he is capable to raise to an A

level of achievement in his classes. Although Daniel did not explicitly mention the assistance he receives from his family in schooling, his access to extracurricular endeavors (i.e., boy scouts and Video-production club) points to such support.

In Armando's case, the role of the family in supporting his education seemed reversed; it was not the family that pushed him to succeed; rather he strived to do so for his family. For example, Armando mentioned in his biographical interview that at times he helped his father with his landscape business which shows his actual involvement in his family's wellbeing. In other words, Armando's inspiration to succeed was his desire "to be worthy, to be successful [for his family], you know!" His love for his family and appreciation for their work was a motivator for Armando to grow and become a successful learner.

Teacher support. Consistent with findings from literature (Groves & Welsh, 2010; Kortering et al., 2005; Lambert, 2015, 2017), participant' responses corroborate the importance of teachers in students' learning of mathematics. Kartering et al.'s (2005) findings, for example, show that liking the teacher was the most important motive for which students with disabilities picked mathematics as their favorite class (6-14%). Disliking the teacher instead, was a major contributor to choosing mathematics as their least favorite class (over 50% out of 46 students with learning disability). Unlike past studies, however, that talk about the impact of the general education teacher on students' learning (Groves & Welsh, 2010; DeBettencourt, & Braziel, 2005), a unique finding of the current study is related to the instrumental value of the special education teacher and a synergic team of teachers in facilitating student success.

Armando was most vocal about the power of teachers' support or lack thereof in his education and growth, highlighting his interpersonal side as a preference in learning that transpires throughout his interviews narrative and self-generated drawings. Referring to his

struggles in learning mathematics, Armando saw a vulnerability within himself, such as "paying attention" or "asking questions," and a shortcoming of his teachers that, in a sense, were "ignoring" him. As Armando expressed, a major problem was the lack of social support from the teachers who wouldn't come to ask him personally, "Hey man, you need any help?" (Armando, personal communication, April 05, 2019). Consequently, Armando perceived the personal support from a teacher as making an essential contribution to his growth as a person and as a student, making him "feel proud" of himself. The following excerpt epitomizes both his inner thought while struggling with mathematics and his breakthrough through the help of a teacher:

> …sometimes I'll be, sometimes I'll be saying in my own ways that I can't do it, you know, sometimes aaa… but when like, when you come over to me [the researcher as the special education teacher in the classroom] and keep saying that 'You can do it', you know, in inspiring ways, that actually helps me, you know… cause not every day I get that from a teacher… I don't get that from teachers… (Armando, personal communication, April 05, 2019)

When asked about the most important supports received in the classroom, Benjamin simply replied, "You are sitting right here!" Thus, like Armando, Benjamin indicated that the special education teacher from the mathematics classroom represented the main contributor to his success. In a follow up line, he clarified that for him it was "much easier to approach the teacher who was in the classroom for me and my help than it is to just go to the main teacher" (Benjamin, personal communication, April 19, 2019).

In another excerpt, Benjamin explained his positive experiences in 10th grade Geometry class and how the general education and special education teachers were supportive of the learning of all students in the classroom. He indicated that Ms. Xan [general education teacher]

seemed different, "she taught most of the class the way that IEP students would be able to better learn the material." In addition, the special education teacher from the Geometry class and the one from Advanced Algebra class were "really good" because they did not "give up on students" (Benjamin, personal communication, April 06, 2019). Lambert's (2015) research findings show the opposite, how a special education teacher dismantled the confidence and self-reliance of a special education student, Luis, through her emphasis on procedural pedagogy and lack of encouragement for independent and original work. As such Luis, who was blooming in discussion-based mathematics activities, loving "problems that give you problems", reverted to the lowest level in the class and being a "behavior" problem, in a group where the special education teacher emphasized "worksheets which are nothing" to him (p. 12). The negative impact of a teacher's pedagogy and attitude towards the diversity in strengths and needs of special education students is evident in this case.

If Armando and Benjamin acknowledged specific instances in which the teachers in the mathematics classroom were helpful, Caleb and Daniel addressed support from teachers in general terms. As such, Caleb expressed, "like you say certain things that most teachers say to help us remember things." He also referenced the synergy and symbiosis that may exist among team teachers in helping students while at the same time "they can kind of help each other" (Caleb, personal communication, May 03, 2019).

Daniel perceived that his learning experiences with mathematics were "decent" because he "always had another teacher in there [the classroom]." Having two teachers who explained the concepts in different ways helped him identify between learning options what fit him best and situate himself as a mathematics learner. He specified, for example, "one [teacher] will show me

one way and the other one will like, have another way as well and I just usually pick which one is the easier way" (Daniel, personal communication, April 10, 2019).

All four students implied the use of differentiation strategies by their teachers to address their difficulties, without seeing or naming them as such. For example, Armando stated, "You have taught me real shortcuts, differently than what the teacher teaches us" (Armando, personal communication, April 05, 2019). Indirectly, he highlighted differentiation strategies implemented by the special education teacher that worked for his way of thinking. Benjamin found comfort in directing questions to the teacher "that is specifically in the classroom" for him. Mentioning two special education teachers that do "not give up" on students confirms the effort they make in accommodating all students' behaviors, difficulties, and needs (Benjamin, personal communication, April 19, 2019). Daniel instead uncovered his own way of learning from listening to differentiated methods of solving problems. Finally, Caleb talked about memory strategies used in the class to aid students "remember things" (Caleb, personal communication, May 03, 2019).

Peer Support. Literature studies (Groves and Welsh, 2010; Kortering et al., 2005) suggest that friends, peer support, and/or teamwork are an effective strategy in helping youth to understand algebra and/or motivate them to be successful. In the current study, Armando and Daniel disclosed peers/teamwork as an essential aspect of their learning. Both seemed to be more social, valuing the participation and success as a team rather than alone, as individuals. Armando was particularly vocal about the value of "group work" in order to "understand each other" (Armando, personal communication, April 12, 2019).

The literature suggests (Lambert, 2015) that Latino/as students show in general a preference for working together. To Armando, therefore, learning and succeeding as a group

appeared to have significance for his academic and personal success. In his opinion, work was "about, you know, working with others" (Armando, personal communication, March 27, 2019). In addition, in his second drawing, he portrayed the future of education as dependent upon team effort (Appendix I). If Armando explained how students can help each other learn, Daniel went in further depth revealing he learned best when helping others. He specified that when he works with peers, he likes to be asked questions "just hoping the others can [through his help] know about the subject more" (Daniel, personal communication, April 10, 2019).

In a discussion during the focus group meeting, Armando indicated that the quality of the peers matters in helping each other better understand the material and work through problems. It represents a unique finding of the study indicating not just that some students enjoy working in groups and socializing (Kortering et al., 2005) but also, when this type of learning strategy is not helpful. Armando, for instance, mentioned during focus group interview, "it depends [the success of group work] to whom you are next to," and continued, "if you are next to somebody that just wants to copy your work and not do anything, then yes, it's not gonna be useful for us. If you are with somebody that's gonna be like, you know like aaa… like nobody is dumb in that class, we cannot say that, but somebody that actually does his work, and has good behavior and all that…" (Armando, personal communication, May 17, 2019). In the previous statement Armando underscored that in order for teams to be successful in helping each other learn all students need to be involved. Benjamin agreed with Armando's statement although he usually complained during class when he had to work with other peers. He evoked in the focus group interview his thoughts related to group work in the AP history class:

That's true. Like in my history class is actually a little bit better working in groups because everybody in there is hard working, they are very… it is an AP class obviously

so most of the kids are magnet, most of the kids are hardworking, most of them know

what they are doing, not know what they are doing (correcting his thought), most of them

have a good idea of what they should be doing, and overall is just… comparing to like

my math class where barely, I wouldn't say barely anybody, that's kind of an

overstatement (again correcting his statement), I would say a good amount of the people

in there just don't care. (Benjamin, personal communication, May 17, 2019)

Although Benjamin preferred independent work, he voiced during the focus group

interview that the perceived involvement of his peers in their own schooling made him

appreciate and see value in group work. Benjamin had been in several occasions critical of the

behavior and lack of participation in learning of his peers from the mathematics class. In his

opinion, "there are some kids in the class that are beyond help." (Benjamin, personal

communication, April 19, 2019). Although they are given "so much extra credit work and bonus

stuff" students are still not doing their work. When questioned as to why he saw his colleagues in

the mathematics class as not motivated to learn, he explained,

Well, that's more of an attitude built up over time. My opinion. It is more an attitude of,

'Oh, I failed so much before, why start trying now or something like that?' Or if they

used to succeed and they start failing somewhere along the lines, [they might say] 'Well,

you know, forget this!' (Benjamin, personal communication, May 17, 2019)

Thus Benjamin, although was not fond of working with others, was able to accurately

differentiate when peers are helpful to his own learning and success and when they were not.

Unlike Armando and Benjamin, Caleb did not voice whether peers help him or could help him in

the mathematics classroom. His involvement, however, in elective and extracurricular social

activities, such as chorus, the gaming club, and performing in a theatre point to a social circle of

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peer support outside the classroom where he gets to "hang out with friends" (Caleb, personal communication, April 26, 2019).

Daniel went deeper in explaining how peers' lack of involvement demotivates him from setting forth effort toward his classwork and learning. "I am not sure why," he exemplified in the focus group interview, "I am just one of those people that like in a group, like if I see anybody else not doing something, I just, you know… my mind set is just going straight to what everybody else is doing" (Daniel, personal communication, May 17, 2019).

Support from Electives/Extracurricular Activities. The extracurricular and elective choices in which the four participants were involved show a holistic portrait of successful individuals, defined not by mere standardized test scores but by achievement as measured through a plethora of accomplishments in different forms, such as: 1) completion of elective and/or career tech track (i.e., chorus for Caleb and JROTC for Daniel); 2) involvement in extracurricular activities (i.e., Video-production club for Armando and Daniel, swimming for Benjamin, A Cappella group and gaming club for Caleb); and 3) some high level classes in the areas of interest (i.e., Honors Spanish for Armando and AP U.S. History for Benjamin).

The literature shows a correspondence between extracurricular/elective pursuits and mathematics progress, in particular when the activities are STEM related (Bargerhuff, 2013; Blomfield & Barber, 2010; Shifer & Callahan, 2010). Shifrer and Callahan's results (2010), for example, confirmed the positive effect of non-core classwork such as technology and communication electives, liberal arts, and visual and performing arts coursework on math and science course taking performance. The findings of their study show how credit accumulation in certain elective areas uniquely benefits the mathematics and science course taking of students with learning disabilities in contrast to students without disabilities. Other research instead

(Blomfeld & Barber 2010; Eccles et al., 2003) focused on the impact of extracurricular activities on students' positive development. Students' extracurricular involvement was linked to higher academic involvement in tasks, aspirations to higher education, feelings of school belonging, and increased psychological wellbeing. In other words, "like the context provided by family, school, and peers, extracurricular activities form a crucial context of adolescent development" (Blomfeld & Barber 2010, p. 126).

What students learn, therefore, through extracurricular (i.e., before/after school programs and clubs) and elective activities (i.e., nonacademic, non-core classwork) represents a rich source of knowledge for the participants in the study offering them motivational, social, and educational sustenance. The extracurricular and elective activities can boost students' motivation to achieve and help them make connections with mathematics concepts, which in turn supports their learning of mathematics (Shifer & Callahan, 2010). In addition, students are benefiting from the support and encouragement of their activities' teammates (Blomfield & Barber, 2010). All participants in the study revealed that their elective/extracurricular activities had an impact on their mathematics learning, in their motivation to learn, and in their education and personal growth in general.

Armando was the most outspoken and enthusiastic about the support he received from the activities he was interested and involved in. When asked about the link he saw between Video-production and mathematics, for example, Armando replied that it helped him learn how to solve problems and succeed – through efficient communication with his partners. The Video-production class and club, therefore, helped Armando develop cooperative problem-solving skills. This finding suggests that to Armando mathematics is not an individual but a collective endeavor in which peers, mentors, and teachers help each other solve common problems. The

Architecture, Construction, and Engineering club (ACE) also had an inspiring effect on Armando's learning. It helped him understand the importance of mathematics in a real-life setting. He stated,

> I think it does [the work in ACE club has a link to mathematics] because it makes me like, like, it makes me like, like let's say… motivated. Yes, be more into math, like pay more attention to math… Like if I am doing like, like when I am there drawing or making a floor plan I will be like, this is… cause when the other partner is asking, 'Hey, how many inches do you want this?' I will just be like, 'Man, you need to pay more attention into [mathematics] class? This is goanna help you more so get more into math,' you know, it helps me like say, 'Hey, I am going to pay more attention to math!' So, yes, it does actually help me in that way, in that way, you know… (Armando, personal communication, March 27, 2019)

Like Armando, Daniel perceived a link between his extracurricular activities and mathematics. The Video-production endeavor enhanced his application of mathematics knowledge in a real setting. When asked where he uses mathematics, Daniel replied, "for mapping out the places that we will shoot out and audio film" and "when we are editing, we have some sort of math system set up." Further he continued, "we have to put things in the places they are supposed to be, and we have to learn how to use decimals, and fractions, and condense it all around the screen" (Daniel, personal communication, April 10, 2019).

Unlike Armando and Daniel, Caleb and Benjamin preferred independent work. Of the two, however, Caleb was involved in social extracurricular activities that may help him develop the social skills indicated as lacking in his IEP and psycho-educational evaluation. In contrast, Benjamin chose an individual extracurricular activity:

Swimming is more of an individualistic sport. You are still with a team, but it is definitely the individual that counts. You don't have like to rely on your teammates for anything. (Benjamin, personal communication, April 06, 2019)

Benjamin saw a link between his and his peers' effort and their success as a team in AP U.S. history class. In the mathematics class instead, where his peers were not as involved in learning as he was, he preferred to work independently. Benjamin did not perceive a connection between swimming and learning mathematics other than "motivation wise" (Benjamin, personal communication, April 06, 2019). In other words, he understood that the habit of setting forth effort in one activity to reach success (i.e., in swimming) may be transferred to academic learning.

Participants' Views on Learning Mathematics

The subcomponents of the theme "views on learning mathematics" relevant for the participants in the study were: a) perceptions of the mathematics classroom; b) perceived vulnerabilities in learning mathematics; c) perceived assets in learning mathematics; and d) views on disability and learning differences.

Perceptions of the Mathematics Classroom. A close representation of how students perceived their mathematics classroom was illustrated in their self-generated drawings responding to the first prompt (i.e., representing the kinds of work and activities students engage in within mathematics classroom). In particular, Benjamin's and Daniel's visual representations covered a plethora of details. Benjamin's drawing, for example, showed exactly what was in front of him, a specific problem of that time and words that indicate teacher's agenda (i.e., opener, warm-up, notes, practice, and TOD). This visualization implies a structured classroom environment that followed a certain sequence daily.

Daniel included in his self-generated drawing an aerial view of the learning environment. He showed how the desks were situated in relation to the board and the position and role of the main characters in the classroom. The general education teacher appeared in a more central position, at the white board, teaching and addressing students. The special education teacher was represented to the side, watching over and ready to intervene as needed. Each student displaying behaviors that stood out to Daniel were represented in detail, while the other classmates were overlooked. Caleb and Armando showed no details about the classroom environment. Caleb drew himself alone seated at his desk. Armando instead depicted himself bigger in comparison to a few peers/friends represented as chatting.

In the literature, the classroom culture and habits were documented through researcher's observations (Lambert 2015, 2017). In the current study, however, the participants are the observes of the educational environment.

Perceived Vulnerabilities in Learning Mathematics. Each student was able to express in detail their vulnerabilities in learning mathematics. In the following excerpt, Armando described his struggle with attention, anxiety of asking questions, and slacking, while pointing out as well to some vulnerabilities that were not under his control, such as teachers' involvement in students' learning:

I guess, I wouldn't really pay really much attention. I would, aaa… I would just look, and I wouldn't ask questions, I'd say… I could say I was like, kind of like nervous to ask a question… Now, now I feel confident asking a question, it is not a problem asking a question right now. But freshmen year, I was a little bit, you know, I was a little bit slackly, you know… So, I wouldn't ask questions, I would just look, I would just copy down, you know… I learned right now that that's not gonna help us, you know, only

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copying down, you know so… That's way freshman year kind of, I was kind of tripping

off, you know, cause… they wouldn't tell me, 'Hey, Armando, what's this?' you know…

cause they wouldn't pay attention if I was really paying attention or not… (Armando,

personal communication, April 05, 2019)

Armando also mentioned memory difficulties and transferring information to a new

situation. "When a new unit comes," he indicated, "the first time when I see it, it doesn't come to

my mind 'Oh, do this, do this, do this'… sometimes I show a little bit, 'Oh, I forgot how to do

this, and how to do this.'" And further he stated, "sometimes my brain is like, 'What's the next

step, what's the next step?'" When Armando needed to perform the next step in solving a

problem, he told himself, "I forgot how to do this step, I forgot how to do this step" (Armando,

personal communication, April 05, 2019).

Armando also specified similar difficulties with mathematics reasoning. Words in

particular can be confusing to him, which might be related to a language and/or compromised

auditory processing difficulty. He stated, "when it is like a sentence and it shows like math

problems, you know, I kind of get like confused on that" and "when it is like word problems I'm

just like, you know, kind like tripping of" (Armando, personal communication, April 12, 2019).

He expressed that it was easier if he saw "just normal numbers." Yet, he did not perceive having

difficulties with word problems or with worded questions any more than his peers experienced

them. He stated, "I know other friends that say that they don't like word problems, you know"

(Armando, personal communication, April 12, 2019). Armando's difficulties were documented in

his IEP and/or psycho-educational evaluation and are similar with those highlighted in the

literature (Geary, 2011; Lambert et al., 2019).

In general, Benjamin did not like mathematics; he named it as his least favorite class. He saw Geometry as being used "more often" and, therefore, he "actually really did enjoy Geometry." To Benjamin, understanding the usefulness of a concept in real life seemed to be a barrier to his liking or disliking a lesson, assignment, unit, or subject in general. To him, "Algebra is a bit convoluted and whenever are we gonna use it very often unless we go into a specific job or career" (Benjamin, personal communication, April 06, 2019).

In addition, Benjamin found it difficult to adjust to new methods of solving problems. An example is the following statement, "it is the constantly adding new things onto old things that kind of gets me like, 'What? Why can't we just do this [the way he used to solve a type of problems previously]'." Benjamin, therefore, might resists integrating new ways to look at and understand new concepts, as knowledge in mathematics is dependent and built upon previous knowledge. For instance, in 9th grade Algebra, students have learned to solve quadratic equations by using the greatest common factor (GCF) and factoring. In 11th grade, Advanced Algebra adds to the solving quadratics equations repertoire other methods such as completing the square, taking the square root, or by using the quadratic formula. If the answers to the problems in 9th grade were real solutions, 11th grade Advanced Algebra adds to the real solutions, irrational, imaginary, and complex. While finding real solutions became easy to Benjamin, he might have experienced difficulties adjusting to other solving methods for a quadratic equation and answer possibilities for which he needed to check. As such, he might question, "Why can't we just do this [the way he used to solve problems in the past and with which he become familiar and proficient.]" Adapting to new situation, therefore, might constitute a weakness for Benjamin. Very likely this was a relative difficulty for him as his work and his grades showed average proficiency as measured by mathematics standardized tests results. His difficulty in adapting to

new situations was accompanied by frustration when dealing with unstructured assignments, conditions, or environments. For example, he described a situation in his honors Language Arts class in which he perceived the work he had to do as overwhelming due to a lack of guidance and clear direction as of how to complete an assignment. "She gave us a folder, a hanger, a paper clip, a couple of note cards, an envelope, and a bunch of random items," he uttered, "and she literally did a one and a half – I counted the minutes and the seconds – a minute and a half long PowerPoint [presentation of the project she wanted students to complete]" (Benjamin, personal communication, April 06, 2019).

Another vulnerability that Benjamin indicated was related to information processing speed. He stated that, "it takes me a lot to understand topics and everything; I do understand, but it just takes more time than others to understand it." Given his grades in class and on mathematics standardized tests in general (e.g., from middle Bs to As, which sets him at the proficient learner level), the processing information speed in mathematics might appear slower to him in comparation to the processing speed in other subjects in which he is able to perform well at the honors and AP level (e.g., for AP U.S. History he received an A score and thus he is an advanced learner as compared to typically developing students).

Information processing speed, therefore, might be a relative vulnerability for Benjamin, in comparison to his higher speed in other subjects and perhaps to students that are in higher level mathematics classes. Taking "more time than others to understand" could refer to the time in which Benjamin struggles to overcome the resistance and discomfort he feels in learning new methods that are necessarily added to the old ones, as opposed to the actual speed of processing information. In other words, "more time to understand" might represent for Benjamin the equivalent of "it takes me longer to internally adjust to a new situation."

Benjamin indicated also a low level of tolerance to frustration. Although he understood that he learned the same concept in a unit, he perceived that "every day it gets more difficult, the content gets more difficult." "Overall," he expressed, "is just monotonous amounts of work that just seems pointless to do over and over and over and over again" (Benjamin, personal communication, April 19, 2019).

Like Armando, not asking questions was a problem for Benjamin in getting the help that he needed. He indicated that he struggled with it, especially throughout middle school. Although he had an extra teacher in his 7th grade, "which was probably the worst" year, in his opinion, he expressed that he wasn't amenable to asking questions. He specified, "I wasn't very open, and I am still not very open doing that [asking questions] all the time but back then [in middle school] I will not ask anything; I mean, I was silent most of the class period" (Benjamin, personal communication, April 19, 2019).

Caleb's favorite class, like Benjamin's, is history because he liked to learn "about the world, like where we come from". However, unlike Benjamin, Caleb enjoyed mathematics and was interested in a STEM career (i.e., science, technology, engineering and mathematics) in computer science. In addition, like Benjamin, Caleb expressed that he liked Geometry, his favorite part was learning about "sine, cosine, and tan" (tangent). He was also very specific regarding what his "least favorite part of mathematics" was – "systems of equations." Caleb expressed a visceral reaction to his dislike of problems that involve systems of equations. He stated, "like sometimes it can get really complicated, and you have to get like radical numbers and those… like the other ones I can get fine, its's just like trying that radical numbers, it's just like, 'immm… it gets under my skin'" (Caleb, personal communication, May 03, 2019). In the excerpt above, Caleb seemed to have the same difficulties as Benjamin. Specifically, Caleb

showed resistance to change from solving problems by a method he was comfortable with, to new methods (e.g., adding the elimination method to the solving by substitution method of solving systems of equations). Benjamin and Caleb manifested resistance to change or resistance to get out of their comfort zone when presented with a method they were not familiar with.

Another similarity with Benjamin is Caleb's perception of himself as having difficulties in terms of information processing. He stated, "if there is something new, it takes a little time to learn it, like [I need] just a little help here and there." As in Benjamin's case, his grades and progress in class does not show a lower information processing speed (e.g.., he was a proficient learner in Geometry as indicated by his standardized test results) in comparison to average learners without disabilities. Similarly, his reaction to taking "a little time to learn" might be related to his discomfort he strives to surpass when confronted with new material and/or situations. "A little time to learn" perhaps indicates his perceived adjustment time to change.

Caleb, like Benjamin, feels that it will be nice to develop "better mental math". "I know multiplication", he stated, "through memory for most of the numbers up to 10, then I have to count." In another paragraph he mentioned that when practicing for SAT he does not "rely on the calculator that much but it's just crippling" when he has to do systems of equations (Caleb, personal communication, May 03, 2019). By chance, Caleb and Benjamin show similar profiles on the Autism Spectrum disorder. For both, their academic attainment is higher than their ability. Both have good reading skills and perhaps show a relative weakness in mathematics reasoning when compared to their higher reading skills (Happe et al., 2009).

Daniel shares with Benjamin a dislike for mathematics, which in turn might translate into a lower motivation to stay focused and to set forth effort in the class. When asked what his difficulties in learning mathematics are, he answered, "obviously, the math I would say" (Daniel,

personal communication, April 10, 2019). Negative self-perceptions about their mathematics ability of boys with ADHD is documented in previous research (Eisenberg & Schneider, 2007). Daniel confessed that a dislike for mathematics runs in his family. When asked why he and his family did not like mathematics he replied, "we are all terrible at it." He then continued, "we are not terrible, but we are just a little slower at it than most people" (Daniel, personal communication, April 09, 2019). The excerpt points to a processing speed difficulty, however, focusing attention on the lesson or the task at hand might be the culprit in his case, as an alternate explanation for perceived slowness. Daniel's focus on competing external and internal stimuli, as indicated in his drawings to the first prompt, suggest hardships in blocking distractors in order to process mathematical information. In another passage he explains the way he is when he doesn't take his medication, specifically he gets "distracted easily." Kofler et al. (2009) documented working memory and central executive processing difficulties in ADHD students relative to typically developing children. An alternative explanation for both deficits might be related to a sensory overload with information from external and internal worlds that impede their processing of selected information for classwork completion. Giving students with ADHD something of interest would appear to be a more effective practice to improve their working memory and central executive processing to the task at hand (Kofler et al., 2009).

Daniel stated that he gets overwhelmed by numbers and operations with numbers that appear to him without a clear start and ending. "It is kind of hard for me," he explained, "because whenever I take algebra classes is just see like numbers here and here and here and here, that's like you have to do all different functions with all those numbers, it just gets confusing at times" (Daniel, personal communication, April 10, 2019). He further expressed that having the numbers embedded in a real context helped him visualize mathematical problems. For example, when

asked about his strengths in learning mathematics he went back to the Video-production club in which he needed to know "where numbers go and then certain fractions and decimals." When further probed as to how numbers can be applied in the context of Video-production, he explained that "you have to plot it out [an image or video] and kind of figure out what you want to condense into." Mathematics embedded in a real-life application appeared meaningful to Daniel, allowing him to learn through logical reasoning how to use numbers and operations with numbers in that context. He indicated that the numbers themselves without context are just "numbers here and here and here and here" (Daniel, personal communication, April 10, 2019).

Perceived Assets in Learning Mathematics. As opposed to vulnerabilities and struggles in learning mathematics, the participants were less able to articulate their personal assets. Benjamin for example stated, "for a while I thought I have no personal strengths in math." He wondered if being a "realist" was a strength, "cause usually when I am being a realist, I am being quite negative" (Benjamin, personal communication, April 19, 2019). His view of himself as "a realist" might suggest a strength in thinking and analyzing in a concrete and logical progression. His first drawing in which he portrayed the mathematics environment in a very realistic way, points out to a way of thinking in which he can analyze and depict accurately what he perceives. He used a "realistic" approach to work through mathematics problems; and he might do the same in all his endeavors. For example, Benjamin looked at History as a chronological order of events which denotes a preference for facts that are concrete, presented as a logical (to him) progression. Explaining why he liked history, Benjamin stated that he had "a natural thing for liking historical events and what happened in the past" (Benjamin, personal communication, April 19, 2019).

Armando mentioned "listening," "paying attention," and "not that much talkative," in other words, attending or being present to the lesson being taught, as his strength. He stated, "cause if I don't listen in the math class, I am not learning anything." He saw the negative instances and drastic effects of not paying attention when the teachers called on students that were "on the phone" who ended up not knowing "what they are doing." "But," he continued, "if you see the ones that are listening, they're not gonna do that, and you gonna see improvement there" (Armando, personal communication, April 05, 2019). The advice that he gives other students was, "Man, you should be listening."

Moreover, Armando realized staying on task and completing his classwork contributed to attaining higher grades in his mathematics class. "When the teacher passes out the sheets [assignments]," Armando stated, "I finish the same day;" and because he was "on time in turning papers in," he was not "behind" in learning the concepts taught. He named both attending to the lesson or "listening" and task completion as a struggle in the past while during the current year, through personal growth, it became a strength.

Unlike the other participants, Caleb does not mention any strengths besides being "naturally smart" as specified by his family (Caleb, personal communication, April 26, 2019). This single personal characteristic, however, is in U.S. society and culture linked to mathematics aptitude and considered an inborn quality, as opposed to one that could be acquired through hard work (Dweck, 2016). To Caleb, "math is fun." Solving challenging mathematics problems gives him a "rush of adrenaline of some sort" (Caleb, personal communication, May 15, 2019). His enjoyment in working mathematics problems indicated that his interest in the subject and his future career goals acted as strengths – motivators to learn and do well. As he mentioned, "once you get the hang of certain aspects is a breeze," and further, "I am not sure how to put it in

words, like… I like it, I like math. I mean is going to be useful, is useful throughout all life" (Caleb, personal communication, April 26, 2019).

When asked what personal strengths helped him in becoming successful in learning mathematics, Daniel explained, "just being able to like, know, 'Ok we are supposed to be doing this, this, and this and… back to the audio and film situation you have to know where numbers go and then certain fractions and decimals" (Daniel, personal communication, April 10, 2019). This excerpt points to a need to see numbers in context and learn mathematics through the application of numbers to a real-life situation, as in the Video-production example he gave. In actuality the literature suggests that students prefer to learn in context (Groves & Welsh, 2010). Daniel exemplified his preference of learning mathematics through real-life applications in his first drawing to the first prompt as well. He wrote down the distance between objects needed in order to be able to record a film action.

Unfortunately, strengths are infrequently addressed though the IEP process or the literature, implying students might not be exposed to strengths narratives they can internalize. Lambert et al. (2019) for example, addressed this issue and found that some individuals with disabilities can identify strengths or "gifts." The most important assets were grouped in the following categories: creativity/conceptual thinking, multi-modal thinking, and persistence/motivation (p.11). Their data, however, was collected from published memoires. The insights offered by the participants in the current study, therefore, provide additional information about assets that aid students in being successful in school.

Perceptions of Disability and Learning Differences. The participants in the study did not perceive themselves learning differently than their peers, and they did not see disability as an affliction. Those conclusions agree with Lambert's findings (2013, 2015, 2017) which illustrate

students with disabilities build a personal mathematics identity around their strengths and weaknesses.

Daniel declared with candor, for example, "honestly, we all learn differently." He expressed no concerns about having a disability; in his opinion, "we all have our differences" (Daniel, personal communication, April 10, 2019). Armando stated simply regarding disability, "I think everybody has them, you know." When asked if it bothers him having a disability, he affirmed, "it doesn't matter, you know, nobody is perfect, you know…" (Armando, personal communication, April 12, 2019). Furthermore, Armando believes that disability does not constitute a barrier to learning:

Aaa… it really doesn't [matter having a disability], doesn't cause you know, anybody can do like aaa… you know, if they [students] really, you know, really are into it, you know, if they care about their education, then they will going to be willing to like try, you know, and not give up, you know. (Armando, personal communication, April 12, 2019)

Moreover, Armando saw his peers having at times difficulties in problem solving while he did not; as such, he felt compelled to step in and help them. He affirmed, "it is not that I'll be looking at the other peers, but I've been looking at them, and sometimes you know, sometimes they really do not understand, right, and… even I have to help them out a little bit, right" (Armando, personal communication, April 05, 2019). Similarly, Caleb did not perceive any learning differences from his peers. He expressed however learning preferences in terms of visual, auditory, and kinesthetic learning classification, identifying himself as "a mix of visual and auditory" learner (Caleb, personal communication, May 03, 2019).

Like Armando and Daniel, Benjamin and Caleb showed no distress about having a disability. Both expressed that they had a time when they struggled with being identified as such.

When asked if it made a difference to him knowing he has autism, Benjamin replied confidently, "No, I could care less," and in another line, "No, not really, I mean I could care less what people think about that [autism], honestly." Benjamin expressed that in middle school he tried "to make sure nobody [other students] knew" (Benjamin, personal communication, April 19, 2019).

Like Benjamin, Caleb disliked needing specialized instruction when he was younger. He expressed that "by 5th grade something just clicked" and he thought he "shouldn't be doing this [be in special education]." Caleb perceived that his continued placement in special education services was a direct result of his "addiction" to "electronics," indicating his behavior was considered an impediment to his learning and progress in school. When asked why he uses his electronic devices during class he specified, "it's just something that helps me get my mind off" (Caleb, personal communication, May 26, 2019). Benjamin mentioned that he uses his electronic device as a "background noise and an occasional break kind of thing." Benjamin revealed also that he uses a sound machine to help him sleep at night "because silence is just deafening" (Benjamin, personal communication, April 19, 2019). It is possible, therefore, that "background noise" and turning the "mind off" might be a learning difference for both students although they did not categorize it as such. In other words, if typically developing students can focus on teaching and learning and filter noise, students with Autism might need an alternate way to cope with the movement, structure, and noise level from a general education classroom.

Indirectly, the participants' responses point to subtle learning differences that might be difficult for them as well as for any teacher to identify and define. For example, Armando explained how the support received from the special education teacher in the classroom, helped him understand how to solve problems:

I could say the teacher [mathematics teacher] teaches the same thing to everybody, you know so, I could say, I could say they [the peers] are solving differently… I could say like… aaa… like for example, like sometimes you have taught me shortcuts, you know, how to do this… You have taught me real shortcuts… differently than what the teacher [general mathematics teacher] teaches us… sometimes I get confused, you know, and you are like 'Do this, do this, do this' – a shortcut, you know, that maybe others do not even, aaa… solve it that way, you know… (Armando, personal communication, April 05, 2019)

What Armando identified as "a shortcut" was a differentiation strategy that fit his way of learning and processing of information. Daniel instead, talked about how he looked at different ways of solving problems and choose the process that he found more understandable. He stated, "one [team teacher] will show me one way and the other one will like, have another way as well and I just usually pick which one is the easier way" (Daniel, personal communication, April 10, 2019). Indirectly, this situation points to a learning difference; Daniel cannot absorb information like other students, from a teacher that teaches the same way to all. Instead, he finds his own way by scanning through different possibilities.

In Caleb's and Benjamin's situation, the differentiation is even subtler going often undetected by the students themselves and/or by an observer (i.e., teacher or administrator). For example, the special education teacher might know when to let them work independently, when they can participate in group work, or what partners will work best for them. In addition, they both showed a need for a structured environment and an accommodation related to buffering sounds. Benjamin mentioned how a special education teacher in the classroom supports his learning:

Asking questions when needed, if I need it… like basically is more than just asking

questions if I need it. It is also more if I don't understand something, they [special

education teachers] can help me understand it better. It's definitely… it's definitely more

they help me understand math easier then like, if you are just learning by yourself and at

the same time, you are like, 'What the heck' – you can ask them and they will be like,

'Oh, yeah, I can help you out.' (Benjamin, personal communication, April 19, 2019)

The statement that a special education teacher "can help" him understand designates

strategies implemented specific to his needs. He indicated a need as well for reassurance when he

gets anxious or unsecure of how to approach something new.

Participants' Assessment of Mathematics Education

Secondary students with disabilities' assessments on mathematics education theme

comprises three subcategories: a) assessment on the usefulness of learning mathematics; b)

insights about the status quo of mathematics education; and c) views on the future of

mathematics education. The third theme that emerged from the study's data infers the

consequences of current socio-cultural-historical choices, planning, and actions taken for the

future of education.

Assessments on the Usefulness of Learning Mathematics. All participants in the study

indicated they see mathematics skills and knowledge as useful in life. This conclusion is

consistent with Young-Loveridge et al.'s (2006) findings. When asked about the nature of

mathematics, a large number of students from their study referred to the applicability of

mathematics for everyday life (p. 586). The same is true in the current study. Armando, for

example, decided to take a senior class although he already had all the credits required for

graduation. He expressed, "I was planning not to take mathematics for next year… but I was

like, 'man, like you need it… you are into architecture, why aren't you gonna take it next year?'" (Armando, personal communication, April 05, 2019). Through his extracurricular activities (i.e., Video-production and ACE club), therefore, Armando was able to understand the importance of mathematics for his career choice and his success in life after high school.

Daniel specified, "I really think that mathematics is pretty much for a lot of stuff in life." When asked to exemplify, he provided an example of the use of mathematics in real-life from the club he is involved in, "for mapping out the places that we will shoot out and audio film." In another line he voiced, "like the audio and film thing, aaa… we have to learn certain positions to put stuff in and certain feet away that the people have to be from the camera; I mean, that place [mathematics] will be part of everyone's life, kind of." Daniel understood that Video-production cannot operate without mathematics. "Without math I mean," he stated, "we wouldn't know what to do kind of in this [filming]." Although he disliked mathematics, Daniel was also aware that without it, his opportunities in life are narrowed. For him, "not wanting to be able to work at like a terrible place" after he graduates acted as a motivator to learn (Daniel, personal communication, April 10, 2019).

To Caleb, mathematics was fun. In addition, he would like to pursue a career that is heavily dependent on mathematics – computer science. He saw the connection between mathematics and real-life instances and professions. For example, in construction "you need to learn about trigonometry" he illustrated. Regarding his chosen career path, he thought that a person needs mathematics in order to be able to do "like coding and all that stuff" (Caleb, personal communication, April 26, 2019).

Benjamin, like Caleb, saw the use of Geometry concepts in life but regarding Algebra he wondered, "whenever are we gonna use it very often unless we go into a specific job or career"

(Benjamin, personal communication, April 06, 2019). In a different line he goes back to show in what way mathematics is important:

> That's the thing, I don't know if most high school math is going to help me but I do think that the information I am gathering with high school math will definitely help me secure a job in the future and, definitely… yeah… definitely will help me secure a job in the future and be able to understand the job, if it has a lot to do with math, it will help me understand it [the job] better. Like I said earlier, Geometry, you can easily use those skills, like cosine, tangent and all that. (Benjamin, personal communication, April 19, 2019).

Insights Regarding the Status Quo of Mathematics Education. In describing the current status quo of mathematics education, students referred to teachers and their teaching styles and methods; their peers and their behavior in the classroom; and the content of mathematics curricula. The literature suggests similar aspects to those expressed by participants in the current study regarding their teachers, peers, and content (Groves & Welsh, 2010; Kortering et al., 2005; Young-Loveridge et al., 2006).

Teachers' Qualities. Armando's experiences with mathematics education was related to his interaction and help that he received from his classroom teachers. To him, good education occurs when classroom teachers (general and special education) pay attention to each student's work and needs, check "if you need help", and "inspire you" to do better (Armando, personal communication, April 05, 2019). Caleb points to the team formed by two co-teachers and their symbiosis in attending to students' success. He expressed, "if one [teacher] can't answer, like the other one can, or could, they can kind of help each other" (Caleb, personal communication, May 15, 2019).

Like Caleb, Benjamin described his experience in Geometry when both the general and special education teachers were "willing to help everybody." He also indicated that for him it was "much easier to approach the teacher who was in the classroom for me and my help than it is to just go to the main teacher" (Benjamin, personal communication, April 19, 2019). Benjamin talked critically about the standardization in teaching he saw currently undergoing in some classes; "Like", he stated, "don't teach everyone the same blanked way." He suggested instead, "start off that way but if you can tell people are not understanding maybe bring them off to a different area and teach them a different way" (Benjamin, personal communication, April 19, 2019). Finally, Daniel talked about competent team teachers, taking turns in instructing the class and showing different and/or differentiated methods of looking at a problem, which allowed him to find what fits him best. Daniel felt that having two teachers in the classroom was all the help he needed to be successful in mathematics (Daniel, personal communication, April 10, 2019).

The participants' opinions about their educators indicate they appreciated caring teachers and well-adjusted teams of teachers in the inclusion setting. They benefited from different modalities of teaching and flourish when their needs were met in an individualized manner.

Their concerns were related to poor classroom management from the part of the teachers and possibly from the part of the school administration and school's culture. Armando pointed to discipline issues in his class that, in his view, should be addressed such as for example, regarding the use of the phone and/or chatting during instruction. "Like I could say," he uttered, "'I must write you up already' [the teacher should write up the student for disruptive conduct]; I guess we need more, 'do it,' you know" (Armando, personal communication, April 05, 2019). In the excerpt above, Armando conveyed that he would like to see more than just talk and threats from

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the part of teachers in order to remedy behaviors that impede the learning of all students in the classroom.

Peers and Their Classroom Behaviors. Benjamin showed dismay at the behavior of some students in his class. In his opinion, "some kids are beyond help" and the teachers should just let them fail. To him "so much extra credit work and bonus stuff" is given to help students pass and yet, "they don't do it [the work]" (Benjamin, personal communication, April 19, 2019). Daniel drew all students that were "the distraction in the class" (Daniel, personal communication, May 15, 2019) showing how his attention was channeled from paying attention to the lesson toward peers with disruptive conduct. He explained, "I am one of those people that if I see that everyone is doing it [either works or is on the phone] than that's what I will be doing will be doing" (Benjamin, personal communication, May 17, 2019). Daniel's confession shows the high bearing of peers on his motivation to sustain effort in the classroom. Caleb instead did not mention at all the climate of the classroom.

The curricula. The participants in the study voiced that they are comfortable with the mathematics curricula the way it is. Secondary students with disabilities voiced they have confidence in their teachers and the system of education to plan and implement the best curricula that will help them be successful in their life. Daniel, for example, replied when asked what he would change about the way mathematics is taught in school,

> Nothing, I think, cause, I mean, I am not going be a major in it [mathematics] or anything but as long as people that are very high up there know what they are doing with math and passing it down for us to learn, I am fine. (Daniel, personal communication, April 10, 2019)

When asked what he would change in the way mathematics is taught, Caleb simply replied, "I think it is perfect just the way it is" (Caleb, personal communication, May 03, 2019).

Although students agreed on the appropriateness of the content being taught, they opposed the way it was delivered. Students would like to see mathematics in context as opposed to perform just repetitive operations with numbers on worksheets. Benjamin for example stated that "overall is just monotonous amounts of work that just seems pointless to do over and over and over and over again" (Benjamin, personal communication, April 19, 2019). Armando stated about the repetitiveness of worksheets, "Man, like, let's try something new, you know, let's try something new!" (Armando, personal communication, April 05, 2019).

Participants' declarations suggest a procedural way of teaching mathematics in their classes, in which the material taught is scaffolded, adding each day an extra step or concept yet void of meaningful, real-life context. Daniel simply mentioned that all he sees are numbers everywhere and explained how he loses himself trying to make sense of those numbers out of context:

I am just… It is kind of hard for me because whenever I take algebra classes is just like numbers here and here and here and here, that's like you have to do all different functions with all those numbers, it just gets confusing at times. (Daniel, personal communication, April 10, 2019)

All participants specified they would enjoy a more conceptual way of teaching mathematics in which they are able to see how the content is related to real-life situations. Caleb indicated he thinks a lesson would work well if the teacher will do the notes first, and then do a few examples "like the compound interest thing" in which students had to search for a desired car and figure out a monthly payment and the number of years it will take for them to pay it off,

given different interest rates from banks (Caleb, personal communication, May 03, 2019). Daniel expressed the same, that mathematics problems are easier to him in a real-world application. He would like to see "a picture on the board or something" (Daniel, personal communication, April 10, 2019) that will give him some contextual information to which he is able to relate mathematical concepts. He showed this need and preferred way of learning in drawings as well. In his first illustration for the first prompt, for example, Daniel exemplified how he uses numbers on the set for the Video-production club. He understood that the distances matter and was able to visualize how to use mathematics concepts in that particular real-life context (see Appendix M).

Below is presented an excerpt from the focus group discussion (personal communication, May 17, 2019) that shows the unanimous preference of the participants in the study for problems presented in real-life context:

The researcher: So, what would you say that we [teachers] should bring in the classroom to make it more interesting?

Daniel: Making more interesting? More, not just problems, but more like problems that have a reason behind it. It is kind of difficult to explain.

Benjamin: Real world problems. Like kind of… you are talking about problems that have to do with the real world?

Daniel: Somewhat like that but like… Let's say you have a board up and you have a picture on the board, just like a real-world situation, that way it gets everyone's minds off their stuff and actually look at the details on the board and then you put the problem somehow in there. Like, how many feet is Suzie away from Brian?

The researcher: But would people care about it [a real-life problem]?

Daniel: Probably it would be more interesting.

Benjamin: It will be.

Daniel: It has a better chance to attract people's attention than just a normal problem on the board.

The researcher: Ok, we did one problem like that recently in our class too, when we were comparing the grades of two students in statistics, trying to decide who should the school give the prize to. Did that make a difference, to see their grades and figure out [by using statistical reasoning and computation] to whom you will give the prize?

Daniel, Benjamin, and Armando: Yeah.

Indeed, research shows a correspondence between a curriculum based on real-world application and improvements on to performance in mathematics of students with disabilities (Bargerhuff, 2013).

Views on the Future of Mathematics Education. Students' views on how mathematics education should look in the future hints implicitly to their preferred way of learning. As such, both Benjamin and Caleb were proponents of the implementation and use of computers to support learning in the future. Instead, Armando and Daniel recommended social based learning in which students help each other better understand the material and build successful teams. Finally, if Benjamin, Caleb, and Armando expressed views that could have been already implemented (i.e., computers and teamwork), Daniel imagines the classroom into a distant future in which methods of teaching and learning unknown today might be available.

The use of digital technology and the future. Benjamin in particular elaborated in detail how he imagines a classroom in which he is provided unlimited resources that would help him learn. In his drawing to the second prompt Benjamin represented a fully digitized classroom. In his opinion, schools lag behind the technology developments of the 21st century. "I feel", he

expressed, "it would be a lot easier for people to use the technology that they have access to, or they should have access to, to learn the material" (Benjamin, personal communication, May 08, 2019). He is puzzled as of why the society and the school system is "restricting what is available". His recommendation for the future of education simply is to "make technology more widely available to the student body of the school system" and teach mathematics using real-life applications from different fields (i.e., marketing, accounting, engineering, or nursing) that are stimulating. Benjamin emphasized the idea that students "need to see how the information taught applies to their life and their future" and "stuff that has no applicable use should be scrapped" (Benjamin, personal communication, May 08, 2019). Benjamin would like for the school system to "encourage technology to become a part of the learning process over pushing it away."

For Caleb, the use of technology in the classroom has implications not only for his learning but also for his future career. He stated, "since I want to go into computer science, I think that maybe we will be doing stuff on the computer" (Caleb, personal communication, May 15, 2019). The same as Benjamin, Caleb would like to see in the future the use of technology in stimulating learning. In his opinion, technology should be a must in schools "since that's what most people are looking for nowadays, someone who can work in… that can work tech" (Caleb, personal communication, May 15, 2019). Through this statement Caleb implicitly showed how the current school system might fail to appropriately prepare students in the use of technology needed currently in any workplace.

Teamwork and the future. Armando and Daniel indicated they learn better in social context. Both describe a future school environment in which group work flourishes. Armando simply drew in the visual representation for the second prompt, four groups or stations of four students working together. To him, "that's how we are going to succeed, you know, by

communicating, you know, with others" (Armando, personal communication, March 27, 2019).

Through this affirmation, Armando points to another important feature of our current society

namely globalization, with the need for people to develop good relationship around the world in

order to be able to solve today's global problems and those that will arise in the future. Talking

about technology, he expressed concerns about the inability of computer work to accommodate

group learning, although he sees at the same time how it has grown a lot, and how it can help

some students learn:

> I don't think we can see group work right there [working on the computer] cause we are
>
> not basically, we are not basically you know, like… unless we are doing like a project,
>
> you know, kind of like aaa… unless we are doing like a project then all of us have to like
>
> aaa… do a certain part. There won't gonna be like, like, like that much communication
>
> as, as a worksheet you know, cause when you are doing a worksheet you, you pay
>
> attention to others but when you are in at the computer that's like, that's like a distraction
>
> right there. You, you, you see the computer more than you are your teammates.
>
> (Armando, personal communication, April 12, 2019)

The last sentence, "you see the computer more than you are your teammates" shows the

high importance Armando places on communicating, interacting, and learning from each other.

Implicitly, through his wish for more group work as a future hope for the educational system, he

highlighted the status quo of the mathematics classroom in which individual, desk work is

required, and individual performance rewarded at the expense of group work and group success.

In addition, it hints to an issue that is unresolved in our society, the need to find innovative ways

to integrate group work and technology in schools the same as required by the global economy.

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Daniel is a proponent of group work the same as Armando. Although in different mathematics classes they have in common their participation in the Video-production extracurricular activity in which they can trouble shoot and problem solve as part of a group. Referring to what he enjoys most in the Video-production club, Daniel described the quality of the group rather than the activity. "Just the people in there [Video-production club]," he stated, "they are really nice and generous" (Daniel, personal communication, April 09, 2019). Daniel appreciated, therefore, being part of a group in which people were "nice and generous. In addition, the most valuable aspect of teamwork for Daniel was his desire to share his knowledge to help others learn.

Although Benjamin disliked group work, he did not dismiss group stations from his design of a future classroom. "Remember," he indicated, "I did mention group work in that classroom diagram that I gave you [second drawing]. There were areas where teachers could do group work with students" (Benjamin, personal communication, May 17, 2019). While for Armando and Daniel group work meant students helping each other learn, for Benjamin group work implied the teacher helping students in small groups, suggesting more of a remediation type of activity rather than group work per se. Caleb did not mention at all how he feels about and/or what are his experiences with working with others.

Bergerhuff (2013) investigation show how both, technology applications with flexible groupings work in conjunction to support the learning of students with and without disabilities. In addition, Kortering et al.'s study (2005) show that students' highest preference was in group and pair activities and software programs. Interestingly, in their study a higher percentage of students with disabilities indicated a preference for interventions or accommodations that include

software programs to teach algebra (82.9% with disabilities versus 70% for without disabilities; p. 201).

    Exploration into a distant future. Unlike the other participants in the study, who portrayed a successful environment that should have been already in place (i.e., learning through technology applications and group work), Daniel projects his view on education in a distant future. In his drawing, the classroom is in a "giant spaceship" flying among stars where students can learn by "Colonization & Exploration," as he wrote on his drawing. The word and idea of "exploration" epitomizes how Daniel learns best. For example, he talked about team teachers presenting the information in different ways and him "exploring" what works best for him. Also, in explaining how he learns, he mentioned making drawings on the margins of the page, which might represent the inner though "exploration" he uses to work through problems.

    When asked how would this space exploration help him better learn mathematics he explained, "if we are in space and all that and we have all the technology, I think we have more math material to learn and all that," and continued, "I think by then, they'll also find easier ways to learn the material" (Daniel, personal communication, May 15, 2019). Through his vision, Daniel points to possible ways of learning that have not been yet discovered, something different altogether than what exists today. Daniel is inviting teachers and stakeholders to open their mind to unthought possibilities for teaching and learning.

Participants' Views on the Use of Digital Devices in the Classroom

    The participants in the study were either proponents of independent computer work with real-world applications or expect new technology to become available that would integrate digital expertise with teamwork, again related to real-word scenarios. Benjamin expressed his consternation about the availability of digital technology and internet applications on the market

that did not make its way into the classroom. Since they "already exist" he felt that "it would be a lot easier for people to use the technology that they have access to, or they should have access to, to learn the material" (Benjamin, personal communication, May 08, 2019).

Armando brought forth another important point regarding the lack of availability of the most recent technology and digital applications available currently on the market namely, students are drawn to them and therefore get distracted by the newness of the elements that the phones and other portable electronic devices feature. He confessed that sometimes he watched movies on the phone like the other students do because "the movie will be more entertaining". He re-engaged on the task at hand by telling himself, "Oh, man, you know, like, I am not doing my work, I need to be doing my work, you know!" (Armando, personal communication, April 05, 2019). His affirmation suggests that returning to an obsolete way of teaching and/or obsolete way to present the material being taught, disconnected from what the current students are immersed into, might be a continuous struggle for many students.

Caleb brought a unique perspective to the table as well. Since "that's what most people are looking for nowadays, someone who can work in… that can work tech" (Caleb, personal communication, May 03, 2019) it appears counterintuitive why teaching and learning itself is not embedded in the same technology students will be working with as soon as they will enter the working force.

Given that schools are lagging in the implementation of the newest technology advancements available on the market, the use of the phone and/or other portable devices during classroom competes with teachers' efficacy in teaching and keeping students on task. The observed use of personal electronics during teaching and learning by students in researcher's current classrooms surfaced as a topic in probing questions. The use of personal electronic

devices for purposes unrelated to schoolwork while in school shows a direct yet unknown socio-cultural-historical consequence of technological advancements on the learning of students. Using electronics while in class is a recent development in our educational environment; its negative and positive impact is not yet extensively addressed in the research literature.

Each of the four study participants used their phone during class despite prompts and instruction to put it away. Caleb used at times a Nintendo Switch device as well. When questioned as to why this pattern of behavior occurs, each student exposed their own rationalized motive. Armando, for example, answered when queried why he is using the phone:

Aaa… sometimes I listen like, to aaa… to Christian songs, yeah, yeah. Cause I go to church and stuff, you know, I'm not, I'm not that kind of person that you know, does all that stuff [plays games or watches movies on the phone], you know, I'm pretty aaa… personally I think I am good [student], you know. (Armando, personal communication, April 12, 2019)

Listening to Christian music helped him with his life "cause," he stated, "I feel motivated" and "it puts me in a good mood" Armando however recognized that the phone can be a "little bit of a distraction" as sometimes he does watch videos. He admitted that sometimes a movie can be "more entertaining" (Armando, personal communication, April 05, 2019) than schoolwork.

Benjamin instead, uses his phone as a sound buffer. He confessed,

I don't know, like when I sleep at night, I actually have to have a sound machine. Well, I don't have to… but I used to have a sound machine on to the point that now I have to have that sound machine turned on every night, cause, I mean, cause I can't… cause

silence is just deafening… I just can't do silence very well. (Benjamin, personal communication, April 19, 2019)

Although Benjamin uses his electronic device as an auditory appeasement mechanism to control his environment, at times he listens to music or watches videos. "I have been seen watching videos and stuff in class," he agreed, "but I mean, I am still working" (Benjamin, personal communication, April 19, 2019).

Caleb mentioned the same utility for his usage of electronic devices as Benjamin, particularly to "quiet" his mind. He indicated that "it's just something that helps me get my mind off." Unlike Benjamin however, Caleb specified he has an addiction to electronics; in addition to his phone he is using a Nintendo Switch. He identified this addiction as a main reason for having to continue special education services. In general, he is not watching movies; he either plays games or reads information about games that he likes. In his opinion, he learned how to "multitask with it" (Caleb, personal communication, May 03, 2019). When asked why he uses his devices so much during the classroom, he replied, "it's mostly when I, I feel like I'm just aaa… done. Like I, I can feel like I can take a break" (Caleb, personal communication, May 03, 2019). His use of electronics matches his extracurricular activity in the Gaming club and drives his career interest in software engineering:

> I want to learn the ins and outs of it like what makes them tick. Like how… like obviously most people are out there now [working on digital technology] but I… but since I always play on the phone, I play on my device I wonder like… like how it is made… how it works and like how I can improve it?" (Caleb, personal communication, April 26, 2019)

Daniel mentioned, during the focus group interview, that he uses his phone in order to watch short films that would help him get ideas for producing his own and enter with them to win competitions. He indicated,

> I am watching a short film. A short film is for the audio and video class we'll have, he will tell you the same thing [pointing towards Armando, as they are both in the same extracurricular activity], we'll have like competitions and will make like short films for the competitions and sent it off. And I am watching all kinds of short films, seeing if I see ideas. (Daniel, personal communication, May 17, 2019)

If Benjamin could manage the use of the phone while completing his classwork, Caleb needed prompts at times to start or finish his work. Armando had the power of will to his advantage; he was able to tell himself "man, I should finish my work" (Armando, personal communication, April 05, 2019). Daniel was the one who's learning suffered the most from abusing the phone during instruction and practice. He often used it to play games or watch videos. Unlike Benjamin and Caleb, Daniel could not shift attention easily from the phone to classwork and many times got completely immersed and lost on the activity from the phone. Although each participant had important reasons for using their electronic devices, their use might work to their disadvantage by missing important information being taught due to a split in attention and overloaded working memory capacity. Although students' preference for software applications in learning algebra was documented in previous research (Baregerhuff, 2013; Korering et al., 2005), the use of a digital phone and/or other personal devices has not.

Summary

Chapter four presented the results of the study that support the following overarching research question: How do high school students with disabilities experience the process of

learning mathematics in an inclusion class at the secondary level? The chapter was organized in three sections. The first section included an analysis of the data collected through interviews (i.e., in-depth biographical, open-ended, informal conversations, and focus group interviews). The results were presented linearly. The purpose of the within-case analysis was to uncover a comprehensive portrait of each student independently with the identification of significant statements (Ayres et al., 2003).

The second section unveiled participants' visual representations guided by two carefully constructed prompts and their thoughts associated with those drawings expressed in informal conversational interviews. In the first prompt, secondary students with disabilities were asked to represent how they view themselves in the mathematics classroom. In the second, they were prompted to draw how they imagine a classroom that fully supports their way of learning. Data from the visual representations complement the results gathered through interviews suggesting that the use of visual representations may help triangulate the findings in the current study. For example, Benjamin expressed during interviews that he preferred individual work. His drawings confirm his preference. Similarly, Armando's and Daniel's visual representations showed consistence with their stated desire for group work. Simultaneously, all participants' drawings showed some details that were not verbalized during their interviews.

In the third section cross-case results were presented. It contained an analytic examination of the data provided through interviews and visual representations, with a comparison of significant accounts across cases in order to identify categories of statements common to all participants (Ayres, Kavanaugh, & Knafl, 2003). While comparing the perspectives and characteristics of all participants and looking for patterns across the data, four themes emerged, specifically: 1) insights on supports to learning; 2) perceptions of learning

mathematics; 3) assessments of mathematics education; and 4) views on the use of digital devices in the classroom. Each theme had several subthemes that organized the information into manageable and related pieces of information. An explanation of how the themes emerged from the raw data was provided.

Regarding supports to learning, students perceived the general, special education, and synergic teams of teachers as important to their learning. They indicated their family as being involved, accommodating to their needs, and encouraging of their schoolwork and after school activities. Regarding peer support, students were able to differentiate when colleagues facilitate or impede their learning. Finally, the extracurricular activities and social circle of friends from those activities, gave the participants an additional motivational push in learning and succeeding in mathematics.

While the participants were forthcoming in expressing their vulnerabilities, they were less familiar of their assets. Additionally, they did not perceive they had a disability and/or that their disability might constitute an impediment to their learning. Learning was, in their opinion, dependent on students' personal choices and involvement in their own learning. They viewed learning differences as a natural part of human diversity with nobody "being perfect" (Armando, personal communication, April 12, 2019).

Secondary students with disabilities viewed the school environment and the content they are taught as appropriate. They perceived some peers' lack of involvement in their learning as demotivating. They indicated that they would like a teaching pedagogy that focuses more on understanding mathematics concepts through real-life applications rather than following procedures (Daniel, personal communication, April 10, 2019). Vis-à-vis the future of education, the opinions were split between a preference for computer and group work. Both are needed,

however, in our digitized and globalized current society and economy. It suggests that the educational system should set forth resources and effort to integrate technology and teamwork in teaching and learning, in order to equip students with appropriate skills and knowledge for success.

The last theme was related to the use of personal devices in the classroom. Each student expressed their own reason for using them, from a sound buffer for Caleb and Benjamin, to motivational music for Armando, and to interest related for Daniel and Caleb. Each student described how the use of personal devices can be a distraction therefore impeding their own learning. This was an unanticipated finding for the current study. It has high relevance in exposing the need for the educational system to stay not just current but ahead in the implementation of the latest discoveries, digital technology, and applications available on the market in order to keep students' interest focused on what is stimulating and relevant to them and their future – teamwork and success embedded in digital literacy.

The upcoming chapter will provide a summary of the study; a discussion of the findings within Vygotsky's socio-cultural-historical framework (1978); limitations and delimitations of the study; implications for practice, policy, and research recommendations for future research; and the conclusion.

Chapter Five: Summary, Discussions, Limitations And Delimitations, Implications And Recommendations, And Conclusion

Chapter five will include: 1) a summary of the study; 2) discussion of findings within Vygotsky's socio-cultural-historical framework (1978); 3) limitations and delimitations of the study; 4) implications for practice, policy, and research; and 5) the conclusion.

Summary of the Study

The purpose of the current study was to gain an understanding of the challenges that students with disabilities experience in the process of learning complex mathematics at the secondary level and how they successfully navigate through those challenges. The study was guided by the following overarching research question: How do high school students with disabilities experience the process of learning mathematics in an inclusion class at the secondary level?

The literature suggests a scarcity of studies that address secondary students with disabilities' views, holistically and qualitatively (Boyd & Bargerhuff, 2009; Lambert 2015, 2017; Lambert & Tan, 2016, 2017). Their perspectives, therefore, on what impacts their learning of mathematics and their progress in school remains uncharted, and less likely to be addressed in educational practice. As Groves and Welsh (2010) expressed, "students' insights are important as a basis for their active and productive involvement, and where there is a serious intention to improve students' learning" (p. 90).

The research question and subquestions were answered through a qualitative research methodology, from information gathered through different data collection sources. They are specifically: in-depth biographical interviews, open-ended interviews, participant-generated

visual representation to two carefully designed prompts, informal conversational interviews, focus group interviews, document review, and researcher-generated memos to vitalize memory.

The results of the study were organized in three sections. The first section included an analysis of the data collected through interviews (i.e., in-depth biographical, open-ended, informal conversations, and focus group interviews). The second section comprised a presentation of participant-generated visual representations in response to two prompts and their interpretation of their drawings gathered through informal conversational interviews. In the third section were presented the four themes that emerged while cross analyzing the data, specifically: 1) insights on supports to learning; 2) perceptions of learning mathematics; 3) assessments of mathematics education; and 4) views on the use of digital devices in the classroom.

Discussion

The four major themes uncovered in chapter five were evaluated through Vygotsky's socio-cultural-historical theory (1978). The discussion of findings is organized in five subchapters according to the relation of themes to Vygotsky's framework as the pillar on which the study is grounded (see Table 6 below).

Table 6

The four themes and their link to Vygotskian socio-cultural-historical framework (1978)

| Themes resulted from the analysis of the raw data	Theme 1 Insights on students' learning	Theme 2 Perceptions of learning mathematics		Theme 3 Assessments of mathematics education	Theme 4 Views on digital technology
Relation to Vygotsky's concepts	Vygotsky's zone of proximal development theory (1978)	Vygotsky's internalization of socio-cultural-historical mediated processes (1978)	Vygotsky's concept of compensatory restructuring of brain functions (1978)	Extension to Vygotsky's framework (1978): Distant socio-cultural-historical factors.	Extension to Vygotsky's framework (1978): Digital technology in the classroom and its impact on future socio-cultural aspects of education

The first theme, "insights on students' learning" is presented in the context of socio-cultural-historical supports to students' learning through Vygotsky's zone of proximal development theory (1978). The second theme, "perceptions of learning mathematics" is integrated into two important Vygotskian concepts (1978), specifically the development of a child's inner thought as an internalization of socio-cultural-historical mediated processes and the compensatory restructuring of brain functions. The third theme, "assessments of mathematics education," represents an extension of Vygotsky's framework (1978). The socio-cultural-historical beliefs from a defined territory influence the policies, rules, standards, and procedures from within that system, which in turn impacts the views of all citizens from the area. If the second theme covers the internalization of socio-cultural-historical narratives about disability and success from the immediate environment of the child (i.e., family, friends/peers, or school), the third one, considers the extended socio-cultural-historical discourses circulated in society that supports or correspondingly impedes students with disabilities' growth at the same level as their non-disabled peers.

Finally, the fourth theme, "views on the use of digital devices in the classroom" explores the impact of technology advancements on students' learning as a new socio-cultural-historical development that impinges on all aspects of our contemporary life. Unlike the other three themes, who were historical oriented, the last theme has a future oriented socio-cultural-historical approach. It leaves open the chance for humankind to choose an open-minded and just path of development for our educational system and our society by and large.

Figure 5 presents the relationship between the results of the study as it relates to the three main tenets from Vygotsky's (1978) socio-cultural-historical framework (it expands Figure 2)

Figure 5

Vygotsky's framework (1978), tree of its main tenets, and the interrelationships between tenets and results as mediated by socio-cultural-historical influences
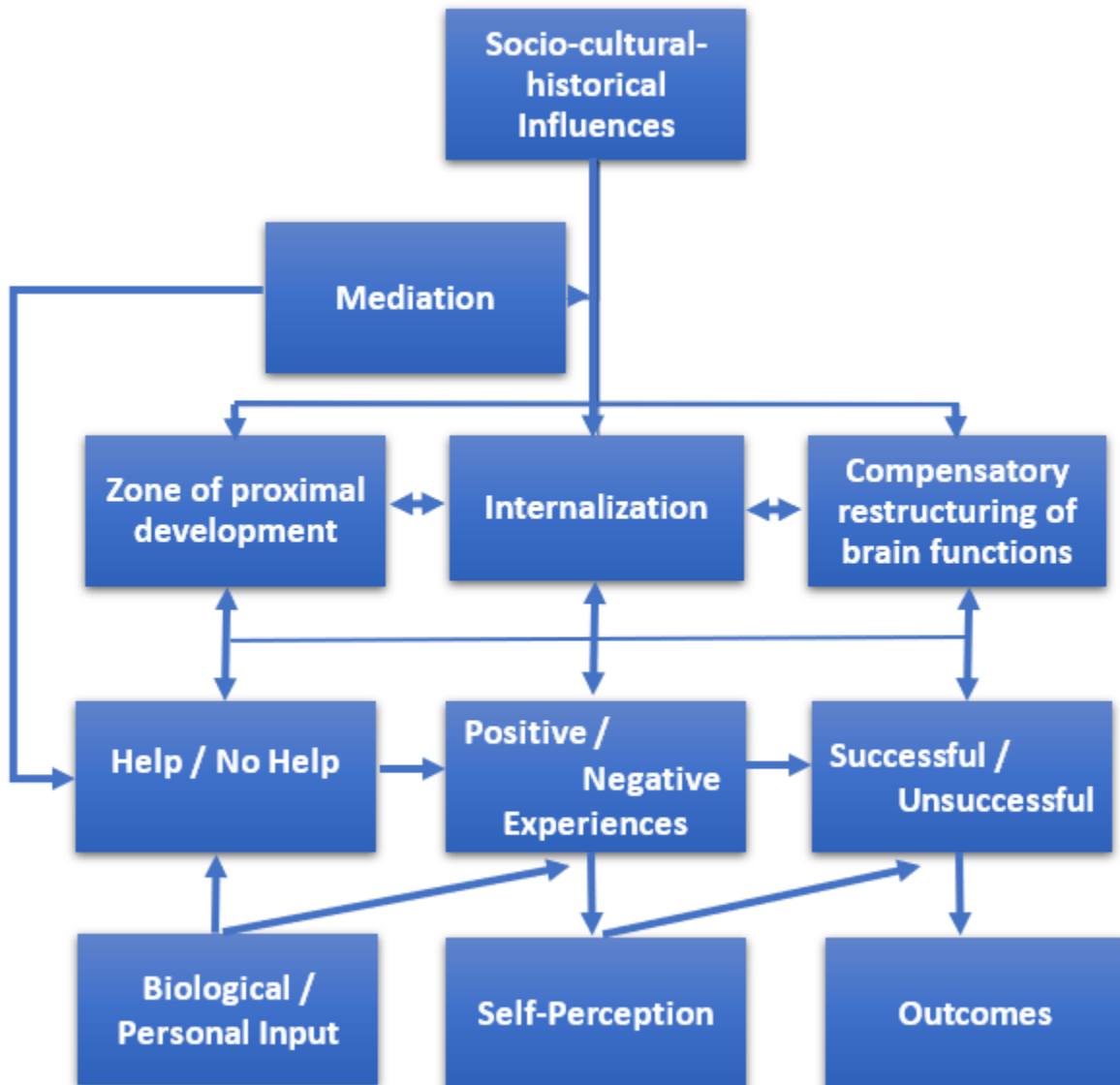
Vygotsky's Concept of Zone of Proximal Development

According to Vygotsky's theory (1978), the zone of proximal development represents "the distance between the level of actual development and the more advanced level of potential development that comes into existence in the interaction between more and less capable

participants" (Cole & Wertsch, 1996, p. 254). It suggests that students with disabilities can succeed despite initial challenges in growth and internal difficulties inherent to their disability through inter-mental interchanges. In other words, students with disabilities can perform on level with typically developing students with the aid of another, more competent peer, mentor, teacher, or parent. The current study uses Vygotsky's concept of zone of proximal development to account for the interdependence between social-cultural-historical context and students' actions necessary for learning.

The results indicate that participants' family, teachers, their peers, and their involvement in electives and extra-curricular activities, have a direct impact on students' mathematics learning and social, emotional, and intellectual growth in general. The literature corroborates those findings (Blomfeld & Barber 2010; Eccles et al., 2003; Groves & Welsh, 2010; Kortering et al., 2005; Shifrer & Callahan, 2010). Through appropriate socio-cultural-historical (SCH) support, therefore, secondary students with disabilities from the current study were able to improve their mathematics skills, knowledge, and grades. The supports that students received may function as intermental interchanges as suggested by Vygotsky's (1978) zone of proximal development theory. More knowledgeable others, such as family, teachers, peers, and knowledge and social support from electives/extracurricular activities might have facilitated students' social, emotional, behavioral, motivational, and academic growth to their potential level of functioning. In Figure 5, the box "Help/No help" designates the supports students receive in order to facilitate development to their potential level in spite of initial difficulties caused by biological and/or personal difficulties.

Vygotsky's Internalization of Socio-Cultural-Historical Mediated Processes

Vygotsky (1978) understood the development of human psyche as a correlation between biological and social events, mediated through "psychological tools" specifically, speech, language, and culture (Akhutina, 2003, p. 162). Through language, human's reflexes become reversible and the consciousness is born as a byproduct of "social interaction, placed inwards" (Vygotsky, 1978). "The world" as a "sign" developed through social experiences, impacts the formation of the human mind. The development of the social and cultural life of a society as well as a person occurs not just in space but in time as well. The term historical, hence, from Vygotsky's theory (1978) designates a view on students as changing through their interaction with the everchanging socio-cultural context.

Perspectives on Disability. Disability continues to be primarily understood in U.S. society and educational system through a medical, deficit model, although alternative models exist (Lambert, 2015, p. 2). This deficit model locates "the problem" within the individual student which prompts research and educational practice to look for solutions to remediate those deficits through targeted interventions. "As long as we understand the problem of disability as only within individuals," asserted Lambert (2018), "we lack the ability to understand the role that contexts play in a holistic sense of disability (p. 130). Students with disabilities are, therefore, perceived in general by parents and teachers more negatively than typically developing peers. Esenberg and Shneider (2007) study, for example, found that students with ADHD were perceived substantially more negative than could be explained by test scores and perceived external behaviors even after controlling for socioeconomic and family characteristics.

The results of the current study show, that when students with disabilities receive appropriate supports, they do not perceive difficulties that stem from their disability any

differently than a difficulty manifested by their typically developing peers. The four participants in the study indicated, therefore, that ability and disability exist as a profoundly human characteristic that belongs to all individuals. Armando stated, "I think everybody has them, you know" and continued in another line, "it doesn't matter [if you have a disability], you know, nobody is perfect" (Armando, personal communication, April 12, 2019). Regarding learning differences, Daniel specified, "honestly, I think that everyone learns differently." Benjamin and Caleb indicated having a disability does not affect them. The literature based on socio-cultural model supports disability as "a difference, rather than deficit, and a measure of human diversity" (Lambert, 2018, p. 8) or "neurodiversity" (Armstrong, 2012).

According to Vygotsky's SCH theory, the participants possibly internalized what they perceived around them, namely that all students learn differently. The results of the study infer, therefore, that students may not perceive disability as an affliction or an impediment to their learning – suggesting that the concept of "disability" might be indeed socially-culturally-historically constructed.

Internalized Language. The impact of language on students' psyche, and implicitly of the SCH views on disability, is perhaps the most evident in students' narration of their vulnerabilities. They match what is highlighted in their psycho-educational evaluation and IEP, suggesting that students might have been exposed repeatedly to hearing those weaknesses to the point where they internalized them. Indeed, Lambert et al.'s (2019) findings reveal a similar conclusion namely, that students with disabilities used "the language of processing" which, concluded the authors, must mean that the insiders (i.e., the students with disabilities) "would need to have explicit conversations" about their difficulties (p. 15).

For example, Armando mentioned during interviews the following vulnerabilities: remembering, making connections with previous learned information when a new concept is introduced, and difficulties understanding word problems or worded questions. The weaknesses mentioned in his psycho-educational evaluation, which are further propagated through the annual IEP are strikingly similar: long-term retrieval, processing speed, and cognitive fluency. Difficulties in retrieving basic arithmetic facts from long-term memory and delays in learning mathematical procedures are in particular documented in research for students with learning disability (Geary, 2011; Lambert et al., 2019). Benjamin and Caleb talked about difficulties with adapting to new situations, needing more time to understand new concepts or new methods, lacking some mental mathematics skills, getting frustrated and shutting down, difficulties in asking for help, and a preference for individual work. The weaknesses associated with ASD are indicated to be moderate to severe developmental delays in communication, socialization, and behavior regulation (O'Malley et al., 2014; Rosello et al., 2018). Daniel perceived mathematics as difficult. "It is kind of hard for me," he explained, "because whenever I take algebra classes is just like numbers here and here and here and here, that's like you have to do all different functions with all those numbers, it just gets confusing at times" (Daniel, personal communication, April 10, 2019). As research specifies, students with ADHD experience central-executive and working memory deficits (Rapport et al., 2008) which are likely to impact all aspects of learning. Daniel's IEP indicated difficulties on working memory and in processing speed.

Students' perceptions of their challenges in learning mathematics, therefore, are closely related to what the literature and students' IEP indicate as weaknesses for each disability. It suggests that the participants internalized words and concepts associated with what was

confirmed by others (i.e., teachers, mentors, family) as unsuccessful actions, behaviors, or learning. They may have internalized past negative experiences associated with learning mathematics which in turn impacted their self-perceptions as mathematics learners (as indicated in Figure 5).

As opposed to vulnerabilities, students were less aware of their assets, characteristics that are less emphasized in the IEP process and in general, by teachers in the classroom. Benjamin for example expressed, "for a while I thought I have no personal strengths in math" (Benjamin, personal communication, April 19, 2019). He identified "being a realist" as a strength. Armando found "listening" or "paying attention" to be his newly found strength in mathematics and completing his homework on a regular basis. Caleb and Daniel did not mention strengths at all. Participant' lack of knowledge of their assets in learning mathematics hint to a school and society environment that frequently focus on students' weaknesses. Participants' knowledge of their vulnerabilities and lack of knowledge of their assets suggest that our SCH view on disability impacts students with disabilities' self-perception as competent mathematics learners.

As Armstrong (2012) expressed, more effort needs to be set forth into detailing the positive attributes of students with disabilities rather than their "deficits" (p. 10). He further highlighted that a "neurodiversity perspective" as opposed to a disability one, would encourage our culture and society to construct "positive niches – advantageous environments that minimize weaknesses and maximize strengths and thereby help students flourish in school" (p. 13).

Vygotsky's Concept of Compensatory Restructuring of Higher Mental Functions

Through studies in brain impairments (i.e., aphasia and motor deficiencies displayed in Parkinson and other clinical syndromes) Vygotsky was able to formulate "one of the principles of modern psychology – the principle of the system structure of the higher psychological functions"

(Akhutina & Palyeva, 2011, p. 165). Through this concept, he was able to underscore the flexibility of the human brain. He concluded that it is not the structure or the functions of mind's development that changes but the relationships or the links between those mental functions. In his interpretation, those flexible, interfunctional as opposed to intrafunctional changes, count the most in the emergence of new mental "constellations." To Vygotsky, hence, the mind is not rigidly determined; rather it can form new systems and therefore, can open the door for new possible function combinations as a "subjective expression of the brain processes" (Akhutina, 2003, p. 23). In Vygotsky's view (1978), development precedes learning in the early stages of a child's life; while later on, learning triggers development and the formation of new links and functions (Akhutina, 2003).

Two implications stem from Vygotsky's (1978) conceptualization of the compensatory reorganization of higher mental functions. The first is that students' disability may affect their learning ability in particular at an early stage in a child's development. The second is that appropriate supports to learning may help them develop compensatory mental functions that promotes their social and academic success.

Armando, for example, talked directly about his growth during high school years. In his first drawing to the first prompt, Armando portrayed himself developing during high school from being sad and receiving Cs in mathematics, to smiling and holding a paper with an A in his hands. The supports in place (i.e., family, teachers, extra-curricular activities) raised his level of confidence which in turn seems to have triggered behaviors associated to success such as paying attention, asking questions, helping his peers, and finishing his work by teacher's deadline. A positive, self-assured attitude changed his learning behaviors from passive to active, which resulted in higher grades. Witnessing positive results from his effort, day after day, reinforced his

successful attitude and behaviors to the point that it had become a habit. Armando choose to take another mathematics course his senior year even though he had the credits needed to graduate, and in a curriculum that offered no support for special education students.

Looking at Figure 5, Armando's path from unsuccessful to successful in all areas of development (i.e., social, emotional, motivational, behavioral, and academic) appears clear. He displayed initial difficulties (Biological / Personal Input) and had no help as mediated through the SCH supports. Next, he internalized negative perceptions of others (i.e., teachers, parent), faced negative learning experiences, and was unsuccessful in learning mathematics when compared with typically developing peers. When "Help" guided him through ZDP, he started to experience a positive attitude toward mathematics, which changed his self-perception as a mathematics learner. In turn, his internal transformation triggered a visible external outcome: his grades increased from a C to an A.

Armando's testimony and growth exemplifies seamlessly how both psycho-educational and standardized tests scores stand meaningless. They do not define what a student is and can achieve in school and his/her life. This supports Vygotsky's conceptualization of ability as a potential, future oriented, and in transformation as opposed to a definite, static, and immutable human characteristic as envisioned by Piaget (Vygotsky, 1978).

Although not explicitly mentioned in interviews, informal conversations, or drawings, Benjamin's and Caleb's growth were evident from document analysis. They progressed from displaying developmental delays at the onset of their schooling, to above average and/or high levels of achievement during high school, through home, school, and extracurricular activities support. Their transition support Vygotsky's (1978) view that development preceded learning at the early stages of Benjamin's and Caleb's school years; while later on, during middle and high

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school years learning triggered their development. The process of transformation exemplified in Figure 5 could explain Benjamin's and Caleb's growth in learning outcomes over the years, as mediated through SCH supports.

Daniel showed consistent difficulties over the years, however, his Eagle status in boy scouts represents a high achievement for any individual. This accomplishment stands as a testimonial of the potential that Daniel possesses to reach success in his postsecondary career path through dedication, diligence, leadership, and teamwork skills. Daniel's extracurricular activities, therefore, triggered his personal development through ZPD (Figure 5). His visible outcomes, such as school grades and standardized test scores, might not have improved throughout the years, however, they are commensurate with Daniel's expected grades in mathematics given he is not interested in pursuing a STEM related career.

The current study's findings infer students with disabilities are not "doomed" to a diagnosis (i.e., learning disability or autistic) or to their identified weaknesses from their psycho-educational evaluations. Furthermore, the findings suggest that with appropriate SCH supports students with disabilities can push through the barriers posed by biological/personal difficulties (Figure 5) and learn how to compensate for their vulnerabilities. Since Vygotsky's theory (1978) is based on the idea of compensatory restructuring of the brain functions, the findings suggest working on students' assets and self-confidence in their abilities might facilitate the development of successful strategies for processing information and learning. As Lopez and Luis (2009) acknowledged, "strengths-based educational models represent a return to basic educational principles that emphasize the positive aspects of student effort and achievement, as well as human strengths" (p. 1). The educational system, therefore, should consider and work on students' assets as opposed to their vulnerabilities in order to trigger compensatory strategies and

positive transformations. Additionally, the findings validate conclusions of previous studies that portray students with disabilities as heterogeneous, complex, dynamic, and successful in a supportive environment (Lambert et al., 2019).

Extension to Vygotsky's Framework: Distant Socio-Cultural-Historical Factors

Students' learning is best developed through interaction with a more knowledgeable other (i.e., teacher or peer) and mediated through cultural principles and practices, as suggested by Vygotsky's zone of proximal development (ZPD) framework (1978). The more "knowledgeable other" individuals from within a system, however, are in turn influenced by general beliefs disseminated through SCH discourses, propagated by scholarly research and media, and further amplified by policy proposals and policy adoptions. "Knowledgeable other" individuals, therefore, might be informed and misinformed at the same time and act, on the basis of evidence believed as correct or appropriate. At times, sound "conceptions" may do more harm than good. A good example is presented in Lambert's study (2015). The school's cultural practices prohibited two students with learning disability, Luis and Ana, from having access to higher level mathematics classes. The explanation was simply that "a conceptual class" would not give those students what they "need" (i.e., appropriate support and a procedural way of presenting concepts; p. 15).

In addition, Lambert's findings (2015, 2017) infer SCH discourses and pedagogical contexts build differently the concept of ability and disability. For example, on a lecture based, procedural approach to teaching, speed and memory were viewed as "proxy" for mathematics ability. In contrast, in discussion-based classrooms students understood success based on a wider range of criteria, such as being creative problem solvers, ingenious problem posers, and positive team partners. In addition, Lambert and Tan's meta-analyses results (2016, 2017) suggest

research literature itself might be biased in the way scholars theorize and examine students with versus without disabilities. Students with disabilities' conceptualization in our society and school system might be frequently minimalized to "deficit views," static and inherent to the individual.

Classroom Level and Peer Quality. Students with disabilities are typically placed in low level mathematics classes because special education support to address their needs are offered only in those classes. Reaching their potential level is not addressed through the laws in place (i.e., IDEA), and therefore, it does not represent a concern for the educational system. The primary interest is placed instead on standardized test scores and percentages of students graduating, since this is what the schools are evaluated against.

All participants, besides Caleb, indicated that peer quality impacted their work in the mathematics classroom. The most affected was Daniel who tended to be distracted by them and also imitate the behaviors of students in the classroom. He stated, "I am one of those people that if I see that everyone is doing it [are on the phone and not working] than that's what I will be doing" (Daniel, personal communication, May 17, 2019). The opposite was true as well in the sense that if the classmates around him were actively involved in their work, then Daniel would likely follow that example. Armando and Benjamin mentioned also the impact of peers' quality in their learning. Both perceived their peers as helpful when all were actively involved in their assigned task, but not helpful when "somebody just wants to copy your work" (Armando, personal communication, May 17, 2019). The low-level mathematics classes, however, tend to contain typically developing students unmotivated for school achievement. The dynamic between special education students and low achievers/unmotivated students hinders teaching and learning for all students.

The majority of students with disabilities are in actuality typically achieving students that might either mature, learn, or process information differently. According to Vygotsky's ZPD theory, students with disabilities need more knowledgeable peers who are able to facilitate the development of their compensatory learning strategies. Students with disabilities, therefore, should be placed in mathematics classes according to their potential, with likeminded peers that possess the learning behaviors and thought processes they can model and from which they can learn in a collaborative environment.

Classroom Level and Measures of Success. Lambert (2015) expressed, "the cultural practices of schooling and sorting children, here the intersection of high-stakes testing, special education and tracking, not only reflected, but constructed certain ideas of ability and disability." Indeed, the participants in the current investigation perceived as having difficulties exactly in the areas emphasized through procedural pedagogy and standardized testing, namely speed and memorization. In Lambert's (2015) opinion, "neoliberal policies which value multiple-choice test scores above all else will continue to create classrooms in which children that cannot memorize procedures and facts are disabled" (p. 408). When success is measured narrowly, therefore, less students are able to show proficiency.

When viewed holistically, more students can enter into the "successful" category. In the current study Armando and Daniel had difficulties passing most standardized tests in high school while Caleb and Benjamin did not. Yet, if all their activities and accomplishments are taken in consideration, all four participants showed growth over the years and presented themselves as very successful students. Taking in consideration Vygotsky's (1978) framework (Figure 5), focusing on students' achievements beyond standardized tests, may impact their self-perceptions and internalization of success as learners. In order to support the growth of all students, hence,

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the educational system should implement holistic measures of learning and success that includes achievements in non-academic classes, bilingualism/multilingualism, and involvement in extracurricular activities in addition to academic progress and standardized test scores.

Extension to Vygotsky's Socio-Cultural-Historical Framework

The impact of technology in the learning of students with disabilities has been documented in the literature. The use of personal devices, however, especially the digital phones during classroom, are a new development within the technology trend of the 21st century. The digital technology affects the way students and people in general interrelate with each other, browse for information, shop and find entertainment, learn, and work. Digital technology might be triggering an important socio-cultural-historical (SCH) change. It is social because it affects human communication and interconnections and it is cultural because is prompting the spared of new customs, rules, procedures, and language. The literature documents the positive impact of technology use and its applications on students' education. The following excerpt from Bargerhuff's (2013) study, shows the advantage of using technology for learning and for accessing accommodations:

> The school assigned all students a Netbook for classroom and home use. Students who needed text read to them could unobtrusively access the reading selection during class using their Netbook and headphones. One student had a dictation software program to compensate for deficits in written expression. Interestingly, far from being embarrassed by his need for assistive technology as some SWD [students with disabilities] would be, this particular student delighted in showing others how the software worked (p. 14).

Technology, therefore, as viewed through Vygotsky's SCH framework can possibly become for students with disabilities (and for all students) a more "knowledgeable other" that

would guide them to reach their potential through the ZPD (Figure 5). All participants in the study used a cellular phone during teaching and learning for differentiated purposes. Caleb and Benjamin found it useful as a sound buffer or background noise, Armando to listen to motivational songs, and Daniel to search for short film ideas. The cellular phone, however, were found to be a distraction to the participants as per their responses. They all confessed they have used it to watch movies or play games during class instruction and/or practice. Benjamin admitted, "I have been seen watching videos and stuff in class" (Benjamin, personal communication, April 19, 2019). Caleb affirmed that he switches to his electronic device when he thinks he is done with the work and feels like he "can take a break" (Caleb, personal communication, April 06, 2019). Armando recognized that "sometimes the movie will be more entertaining" than the lesson (Caleb, personal communication, May 15, 2019). As for Daniel, he was likely to imitate what everyone else was doing – being on the phone if peers around him were on the phone. Technology, therefore, appears to be having positive and negative influences on students' learning.

Related to Vygotsky's (1978) SCH framework, the use of digital technology might suggest a reconfiguration of the higher brain functions (i.e., attention, memory, or processing speed) of our current students to accommodate the way they access information, are required to multi-task, are subjected to fast-pace changes, and communicate with and through technology. Moreover, how our society tackles the new SCH developments due to digital advancements, will have an impact on the growth and well-being of our future generation of children. Our society and educational system, therefore, is presented with the option to build a new path for the upcoming generation of children geared toward an open-minded, inclusive, and kind environment beneficial to the holistic growth of all children.

Limitations and Delimitations of the Study

The current inquiry employed a qualitative case study design in order to reach a deeper understanding of the perspectives of high school students with disabilities from two inclusive secondary mathematics classrooms. The study was bounded by the socio-cultural-historical context of the school and classroom setting in which the inquiry took place. Specific to qualitative inquiries, the results might not generalize to all classes, public institutions, and/or to all students with disabilities. The current study, however, was not seeking a "veridical representation so much as stimulation of further reflection, optimizing readers' opportunity to learn" and reach "naturalistic generalizations" as they relate the findings to their own experiences (Stake, 1995; p. 42).

A closely related limitation was represented by an inability to choose a purposive sample of participants that would cover a wide spectrum of positions and perspectives in relation to the studied phenomena (Palys, 2008). Instead, a convenience sample was used which limited the data collection to students that volunteered to share their opinions and experiences. The sample included participants belonging to different eligibility categories which helped in showing the diversity and complexity of students with disabilities. In addition, students with Autism and Attention Deficit Hyperactive Disorder are less approached in qualitative studies focused on revealing their perceptions (Demaray & Elliott, 2001). A sample of participants from the same eligibility group, nevertheless, might yield relevant and robust information about students' opinions from that specific disability group.

Another limitation common to all qualitative studies was introduced through the sensitivity, experience, and integrity of the researcher as the "primary instrument for data collection and interpretation" (Merriam, 1998, p. 43). Even in the presence of outstanding

knowledge, skills, and self-awareness, a researcher cannot totally avoid her own subjectivity. Subjectivity, however, does not have to be eliminated but rather seen "as an essential element of understanding human activity" and exposed as part of the research (Stake, 1995; p. 45; Stake, 2010; p. 29). In addition, triangulation methods such as professors' checks were implemented in order to minimize inadvertent biases.

Being an insider researcher, as the special education teacher in the classroom, was a major limitation of the current study. It posed, in addition to issues of subjectivity and biases, the following problems: gaining access, confidentiality, power struggle, and shifting through social identities. An insider researcher might be perceived as "either too much of an insider (assumed that he/she knows the situation; participant is not forthcoming) or she is seen as too distanced from the group to trust with information, much like an outside researcher" (Greene, 2014; p. 6). There are no easy solutions to navigate smoothly through the relationships-dynamics represented by students as contributors and the internal researcher. In addition, it is hard to distinguish the line indicative of how much information to ask for and to share without hurting the participants. Good planning of the research, full disclosure of researcher' intentions, reflexivity and positionality discussion, developing and maintaining an audit trail, and employing triangulation methods were used to alleviate those challenges (Greene, 2014).

Implications for Policy, Practice, and Future Research

Implications for Policy

The four high school participants in the current study "remind us that there is no single profile" of students with disabilities (Lambert, 2015, p. 16). Each had some common and some unique characteristics related to them as individuals. Each showed different interests, passions, and career choices. In addition, two of the participants were bi-lingual (i.e. Armando in Spanish

and Caleb in Swahili) and one was also identified as gifted (i.e., Benjamin). Their standardized test scores as compared to typically developed peers were from low C to high A. Those differences in characteristics, interests, and grades indicate that students with disabilities should not be aggregated into a single category. Our society and educational system need to find equitable ways of grouping (if at all) students and reporting scores.

Furthermore, when analyzed holistically, the participants presented as successful, complex, dynamic, resilient, and with a multitude of strengths and achievements that go unacknowledged by the current school system. Analyzed holistically, each participant appeared as successful in their school grades and extracurricular accomplishments. The current study, therefore, suggest that success in school should be measured using holistic methods (i.e., achievement in different elective/career tech classes, proficiency in different languages, and involvement in extracurricular activities) as opposed to narrow methods (i.e., based on standardized test scores alone).

The participants in the current study were not placed in higher level mathematics classes due to a lack of special education support to accommodate their needs. Findings from other studies in the literature (Lambert 2013, 2015, 2017) corroborates such practices. In the following excerpt, Lambert (2015) described an instance of placement discussion between a general education teacher, Ms. Marquez, and a special education teacher, Ms. Alton, regarding two students with learning disability, Luis and Ana:

> Ms. Marquez wanted Ana in the most advanced mathematics class for eighth grade. Ms. Marquez spoke of creating a class for Luis that stressed conceptual learning over rote memorization. Ms. Alton disagreed with both suggestions. A conceptual class, she argued, would not give Luis what he "needs." According to Ms. Alton, Ana should not be

in the advanced class because she needed "additional support." Ms. Marquez was visibly angry during this interview as we discussed these placements. Ms. Alton was calm, yet insistent that Luis and Ana, and all the children with learning disabilities, needed appropriate "support" and could not be placed in classrooms without it. From one perspective Ms. Alton was simply making sure these children received support services, yet from another perspective, she (and the eighth grade teachers) used discourses of care to segregate children, a practice that disability studies scholars have identified in disability professionals whose jobs depend on such differentiation (van Hove et al., 2012). (Lambert 2015, p. 18).

As a researcher and special education teacher, I recognize that some students might display vulnerabilities that may prohibit them from performing on level in spite of accommodations and supports in place. As the findings of the current study suggest, however, some students could perform on level with typically developing peers in higher level classes if given support, yet frequently the educational system denies them this opportunity. Moreover, students with disabilities who could benefit from similar or more knowledgeable peers are sometimes placed in classes with low-achievement and/or non-motivated students. This placement pattern may put students with disabilities at a double disadvantage. On one hand they may find themselves striving to learn despite their disability and on the other, they have no peers with whom to relate and from whom to learn in order to compensate for their vulnerabilities. As Lambert's findings (2015) indicate, the placement of students with disabilities in lower classes might be a discriminatory practice. This finding asks for a social-justice response from our society and educational system to correct educational inequities for students with disabilities (Gutierez, 2013).

Implication for Secondary Education Practice

As the results of the current study suggest, participants' assets in addition to supports, helped them navigate through the challenges of complex mathematics and grow into self-confident and capable mathematics learners. The participants indicated a dislike for a procedural pedagogy which caters generally to address vulnerabilities. They found a context-based teaching approach as interesting and meaningful. Embedding mathematics content, therefore, in real-life scenarios might trigger the development of basic mathematics skills and number sense in students that had difficulties mastering them in elementary school.

The participants in the study were knowledgeable of their vulnerabilities while less aware of their assets. This pattern may indicate an internalization of disability narratives frequently circulated in the school environment and society as reported in other studies (Lambert 2015, 2017). Educators may consider teaching high-leverage strategies (Hughes et al., 2017) in order to "empower students' strengths and to enhance their positive views and effective coping strategies" (Lackaye & Margalit, 2006, p. 444).

Implications for Future Research

Some studies tracked students' achievement longitudinally. For example, Wei et al. (2012) examined math trajectories by disability category and other demographic characteristics using a nationally representative sample of students ages 7 to 17. Mathematics achievement was measured using two subtests of Woodcock-Johnson (WJ III) Test of cognitive abilities. Such studies, however, are quantitative in nature and therefore, the growth of individual students is impossible to track. Additionally, disability studies examine mathematics weaknesses at a certain point in time in the life of a student, at the elementary or middle school level in general (Fuchs & Fuchs, 2002; Gary, 2004). The results of the current study suggest that students with disabilities

can undergo positive transformations over the years and with the right supports are able to compensate for their challenges. Longitudinal and qualitative studies that would examine the changes in students' ability to work through their challenges might bring relevant insights into how they are able to counterbalance the effect of disabling factors and become self-sufficient and self-regulated learners. Lastly, more research is needed to address the impact of cultural differences and English as a second language on students' identification, placement in special education services, and the classroom support required to foster and encourage their cultural and linguistic differences.

Conclusion

Literature findings suggest that students' perspectives on their learning and school experiences are important considerations for research and education (Groves & Welsh, 2010; Lambert 2015, 2017). The current study explored the opinions of a group of students often overlooked in qualitative studies: high school students with disabilities learning complex mathematics within an inclusive setting. Data gathered through a variety of collection methods (i.e., interviews, drawings, document reviews, and researcher generated memos), from four self-selected participants with different disabilities, enrolled in two Advanced Algebra inclusive classes worked to improve the trustworthiness and credibility of the results of the study.

The data was interpreted through the lens of three major tenets of Vygotskian framework (1978) namely the zone of proximal development, internalization of socio-cultural-historical factors, and the compensatory reorganization of brain functions. All three processes are mediated by socio-cultural-historical factors. The results of the study revealed several poignant findings. First, students with disabilities are heterogeneous, complex, possessing different assets, vulnerabilities, interests, and needs, and at different levels of academic achievement (Lambert

2015, 2017). They should not be amassed and labeled in one aggregated category. Students with Autism Spectrum Disorder or Learning Disability, for example, show different profiles of highs and lows in both ability and attainment (Happe et al., 2009).

Second, students with disabilities are able to improve their performance in mathematics and school in general through socio-cultural-historical support received from family, teachers, peers, and elective/extracurricular activities (Blomfield & Barber, 2010; Kortering et al., 2005; Shifer & Callahan, 2010). Third, many students with disabilities are not low achievers and/or unmotivated students (Lambert 2015, 2017). Students with disabilities from an inclusive setting range in abilities and will to succeed from low average to high average and should be offered equal opportunity of placement in different level mathematics classes as their typically developing peers, with support from special education services.

Four, standardized testing is frequently a narrow measurement of students' learning and work and/or college readiness. When measured through multiple criteria of achievement, such as classes taken in the area of interest, cumulative elective credits, involvement in extracurricular activities, and results on standardized tests, all students in the current study appeared as successful individuals. Five, the information from psycho-educational testing should be considered with caution; as the results from the study reveal students with disabilities can show considerable growth over the years. Six, working on students' assets rather than vulnerabilities may work better as an intervention and/or instructional strategy. More studies are needed with a focus on a strength-based approach to teaching and learning to corroborate this finding. Seven, perhaps it is time to cherish human differences in teaching and research. The participants in the study revealed they are comfortable with what and how they are, showing a deep understanding of human differences – "nobody is perfect" (Armando, personal communication, April 05, 2019).

Additionally, all students can benefit from a positive, challenging learning environment, with hard-working peers and enthusiastic, accommodating, and supportive teachers and administrators.

Finally, digital technology may be changing the social and cultural structure of our society. The higher mental functions of our children are possibly restructuring in ways that are not yet known because of their use of technology. The way students learn best, therefore, might be different today than what past research literature suggest. As digital technology advances increasingly in its functionality, public education frequently remains behind in its implementation of equally functional features. It is no wonder that many students perceive education fails to prepare them adequately for success in their career and life – a future working place and life immersed in digital technology. The society and school system might need to invest considerably more in educational technology and digital applications that are on par with what is currently available on the market in order to appropriately prepare students for postsecondary education and career paths and also for the current needs of our society – digitally literate individuals.

Furthermore, students with disabilities might hold the key to understand the direction of human development given the changes that occur in the world (i.e., technology, globalization, resource limitations). Benjamin and Caleb, for example, are well adapted for a technologized world. They communicate, learn, and work well through computer/digital applications. Armando is tuned to the teamwork necessary in a global economy, in which group success has become more vital than individual success. Daniel instead is accustomed to the explosion of information from our current society, in which he is able to find his way to learning, working, being, and

ultimately finding joy in life. In the end, it is our diversity that helps us survive and flourish as a

society.

Unshackled Ways of Thinking
Think. Who is to say how to think? Since when it became a predetermined exercise,
part of a lesson plan? Let the spirit of children learn freely how to search and discover
their own zeniths, for they do not live for today, but for a tomorrow that nobody knows!
(Iliescu, 2017)

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Appendices

Appendix A – Data Collection Planning Matrix

What do I seek to know?	Why do I need to know this?	From which data sources will be answered?
How do high school students with disabilities experience the process of learning mathematics in an inclusion class at the secondary level?	■ Gain an understanding of the challenges that students with disabilities experience in the process of learning mathematics at the secondary level.	In-depth biographical; open-ended; & informal conversational interview
	■ Illuminate how students with disabilities successfully negotiate their challenges and find unique ways to achieve success.	Document review
	■ "The goals we have for students may be disconnected from the ways in which they see themselves now or in the future" (Gutierez, 2013; p. 43).	Participant-generated visual representations
		Researcher-generated memos
	■ Gain an understanding of the profile of current high school students with disabilities in their complexity of abilities and differences.	Focus group interview
How do high school students with disabilities successfully navigate the challenges they face in learning of secondary mathematics?	■ Reveal insights from students themselves about what helps them succeed in learning mathematics, insights that would further inform appropriate intervention models.	In-depth; open-ended; & informal conversational interviews
	■ "A case study researcher gathers as much information about the problem as possible with the intent of analyzing, interpreting, or theorizing about the phenomenon" (Merriam, 1998; p. 38).	Document Review
		Researcher-generated memos
	■ Contribute to building strength-based narratives to help students learn mathematics.	Focus group interview
How do high school students with disabilities perceive their own learning differences within a mathematics class?	■ Show how the current environment looks like for students and what are the environmental supports they perceive as helpful.	Open-ended & informal conversational interview
	■ Gain an understanding of learning differences from students' point of view	Document Review
	■ Learn relevant information for teaching, planning, and support purposes.	Researcher-Generated Memos
	■ Consider the potential impact of school related features on mathematics success.	Focus group interview
How do high school students with disabilities envision an environment they would call academically supportive?	■ Identify students' opinions about what they think would work best for them.	Open-ended & informal conversational interview
	■ Illuminate how the students themselves see a meaningful educational environment that would benefit students with disabilities.	Participant-generated visual Representations
	■ Show the complexity and interdependence of influences on an individual's cognitive functioning and development.	Researcher-generated memos
		Focus group interview

Appendix B – First Prompt for Visual Data

"Think about the kinds of work and activities you do in the classroom. Draw a picture of how a camera will see you when you are learning mathematics in the classroom."

Appendix C – Second Prompt for Visual Data

"Think about the kinds of supports that you need to be successful in learning mathematics. Draw a picture about an imaginary classroom in which you are provided unlimited kinds of features that will help you learn."

Appendix D – In-Depth Biographical Interview Questions Protocol

1. How old are you?

2. Do you live with both parents?

3. What is their education level?

4. What type of job do they have?

5. What is your favorite class in the school? Why?

6. What is your least favorite? Why?

7. What extra-curricular activity(es) do you do? Why do you like it (them)?

8. What career path are you interested to pursue as your first (and second) choice? Why?

9. How does mathematics relate to your activities? How does mathematics relate to your career interests?

Appendix E – Open-Ended Interview Questions Protocol

1. What is your opinion about learning mathematics?

2. Describe some learning experiences that contribute to your opinion regarding the study of mathematics.

3. Describe your views on learning differences.

4. What difficulties do you perceive in learning mathematics?

5. What strengths do you possess that assist you in learning mathematics?

6. What strengths would you like to develop to help you better learn mathematics?

7. What supports do you think help you (or would help you) in learning mathematics?

8. Describe how you best learn mathematics.

9. What would you change in the way mathematics is taught to help you become more proficient?

10. How do you think mathematics proficiency can prepare you for your future career and life?

Appendix F – Focus Group Interview Questions Protocol

1. How do you feel about learning mathematics? What experiences influence your opinion? Explain.

2. What difficulties do you experience in learning mathematics? Explain.

3. If you have had difficulty in learning mathematics, what has helped you – or is helping you currently – to overcome them?

4. What helps you learn mathematics? Explain.

5. What do you think about the importance of mathematics in today's society? How about related to your career?

Appendix G – Armando's First Drawing of First Prompt

"Think about the kinds of work and activities you do in the classroom. Draw a picture of how a

camera will see you when you are learning mathematics in the classroom."
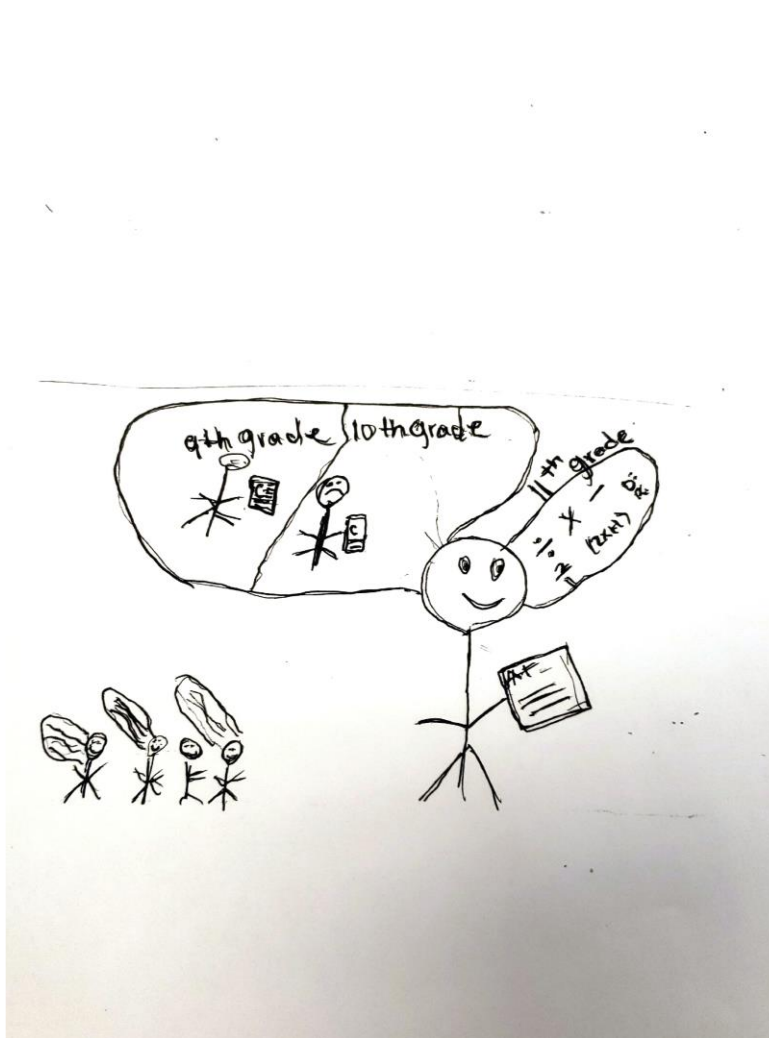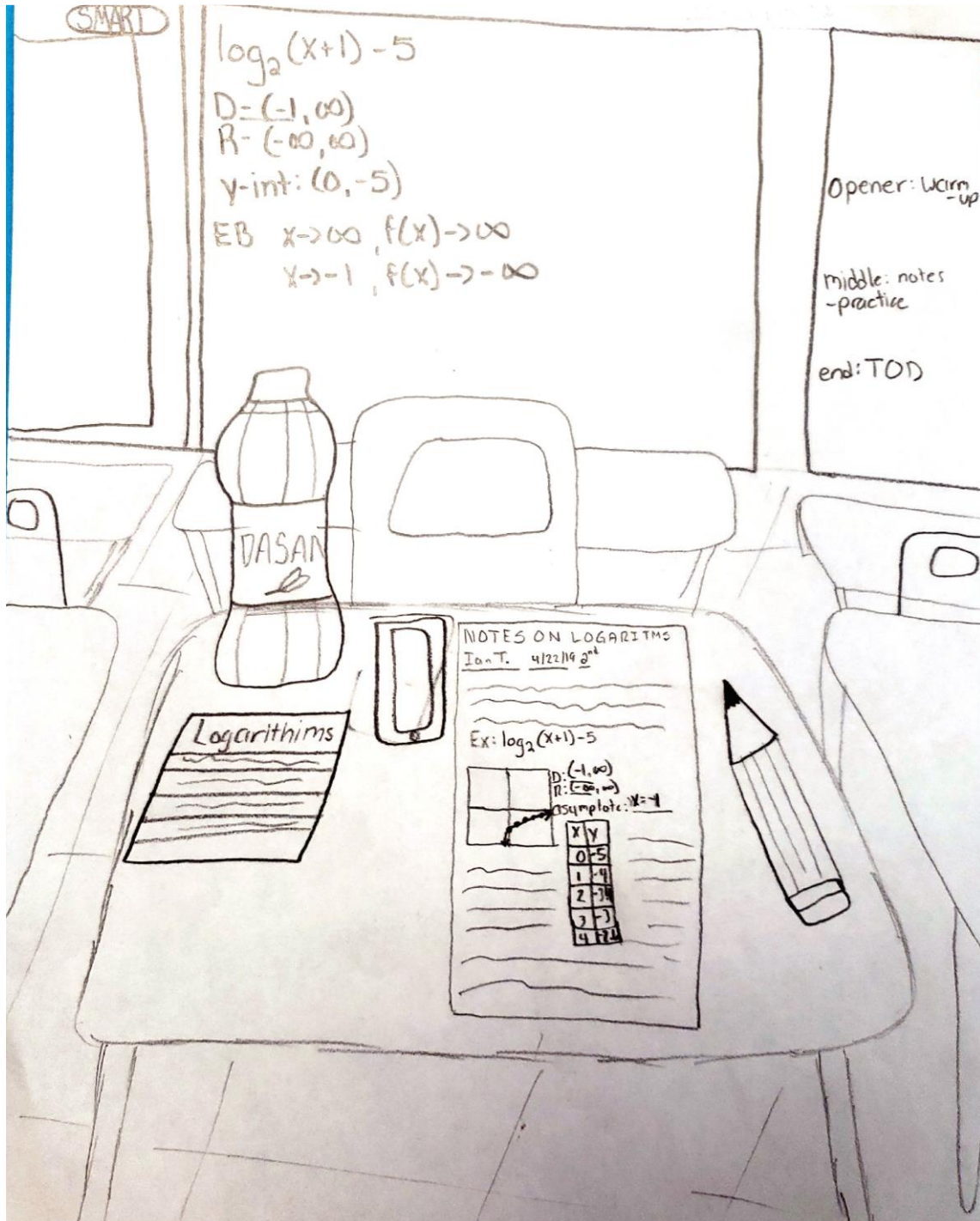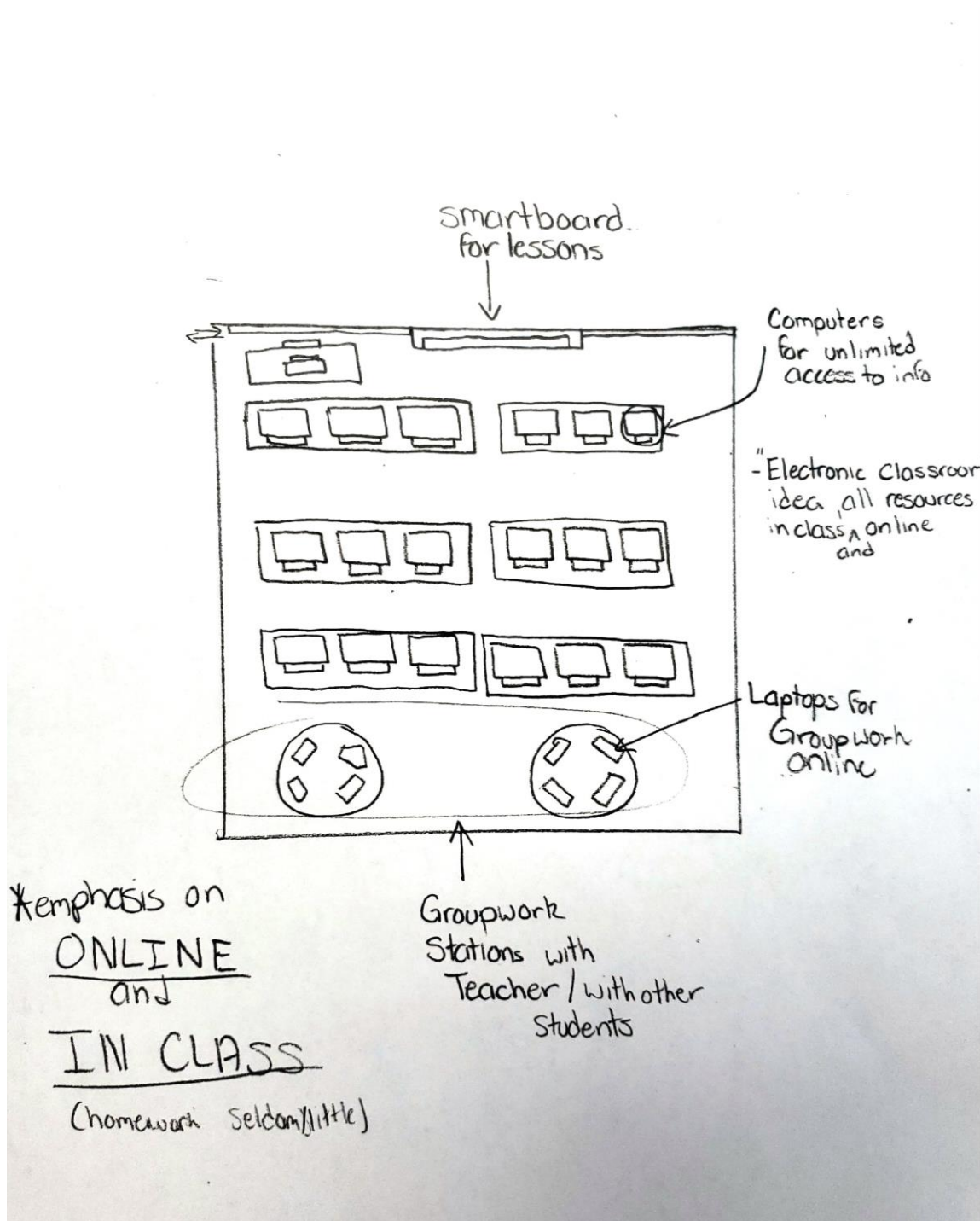
Appendix H – Armando's Second Drawing of First Prompt

"Think about the kinds of work and activities you do in the classroom. Draw a picture of how a camera will see you when you are learning mathematics in the classroom."
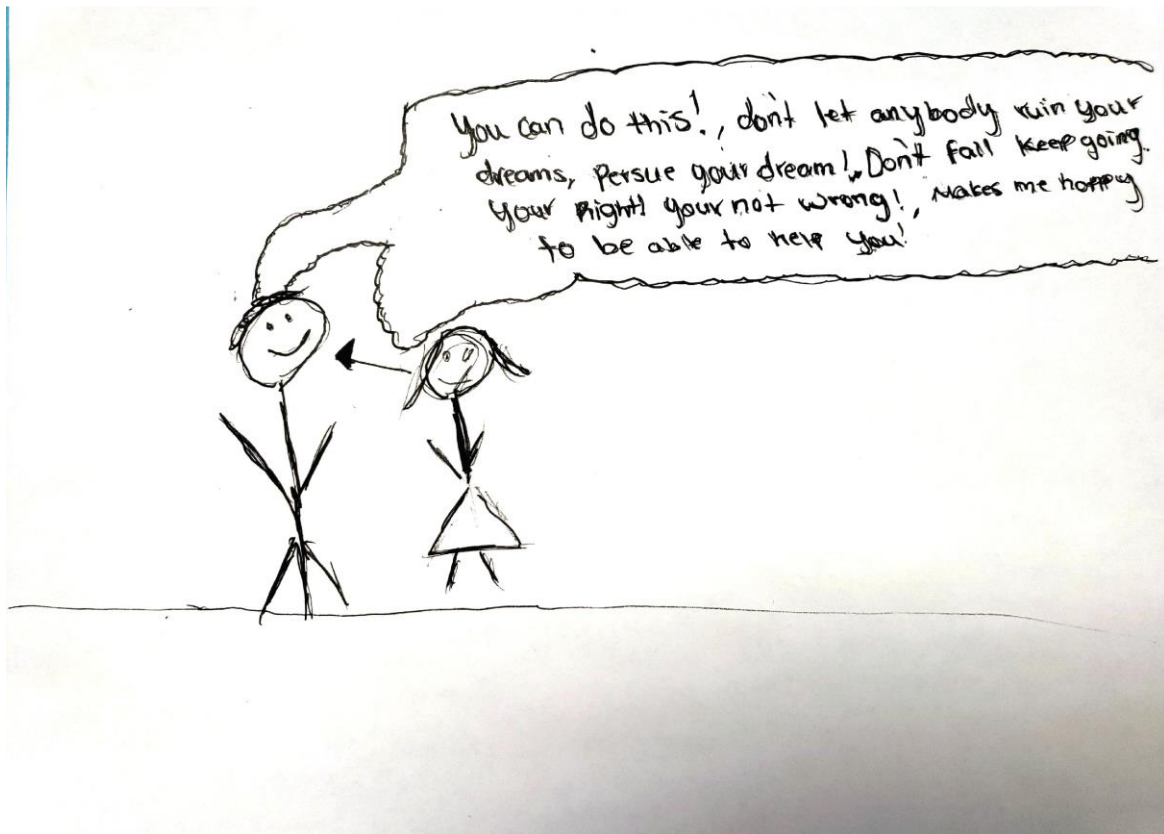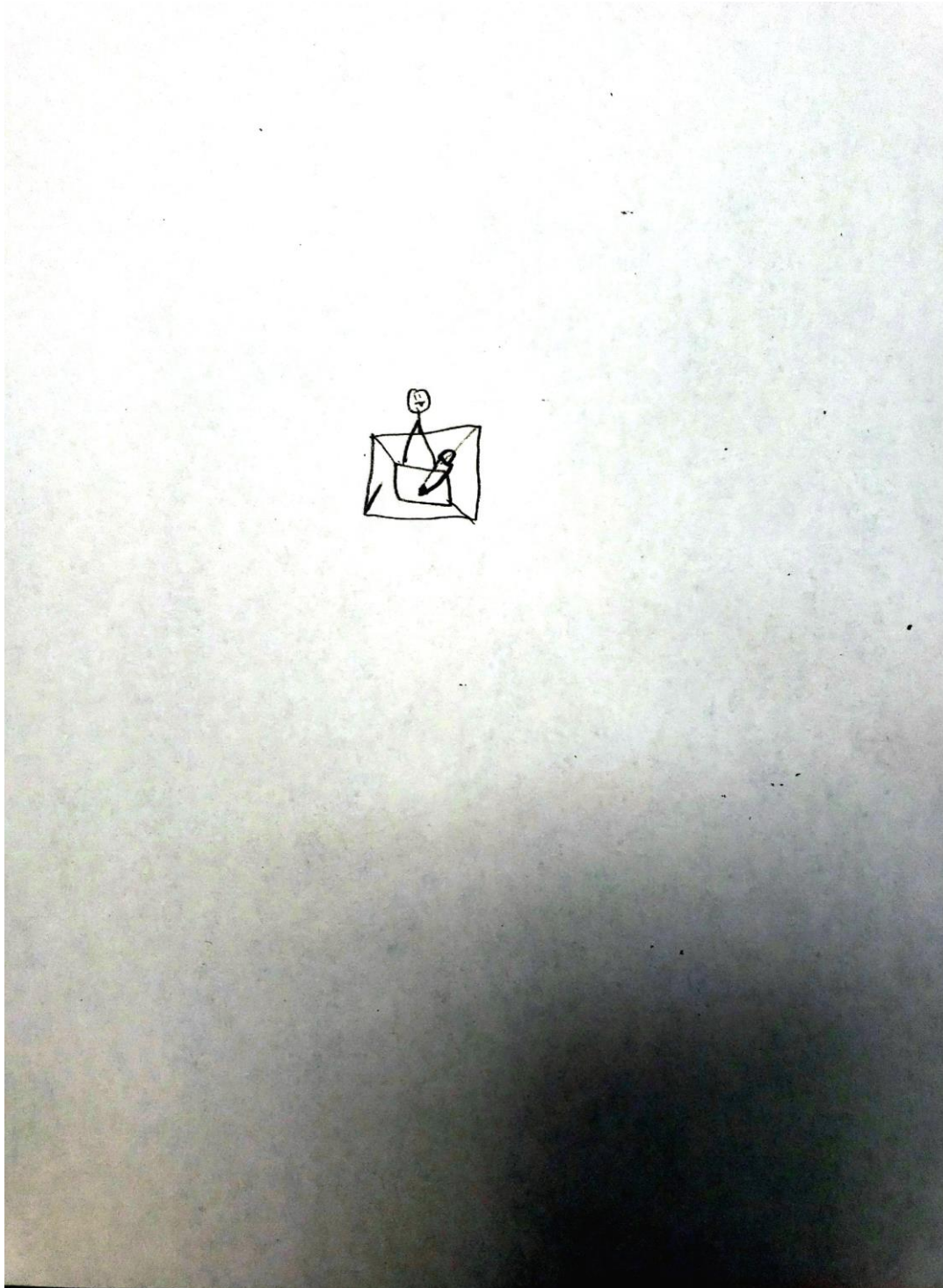
Appendix I – Armando's Drawing of Second Prompt

"Think about the kinds of supports that you need to be successful in learning mathematics. Draw a picture about an imaginary classroom in which you are provided unlimited kinds of features that will help you learn."
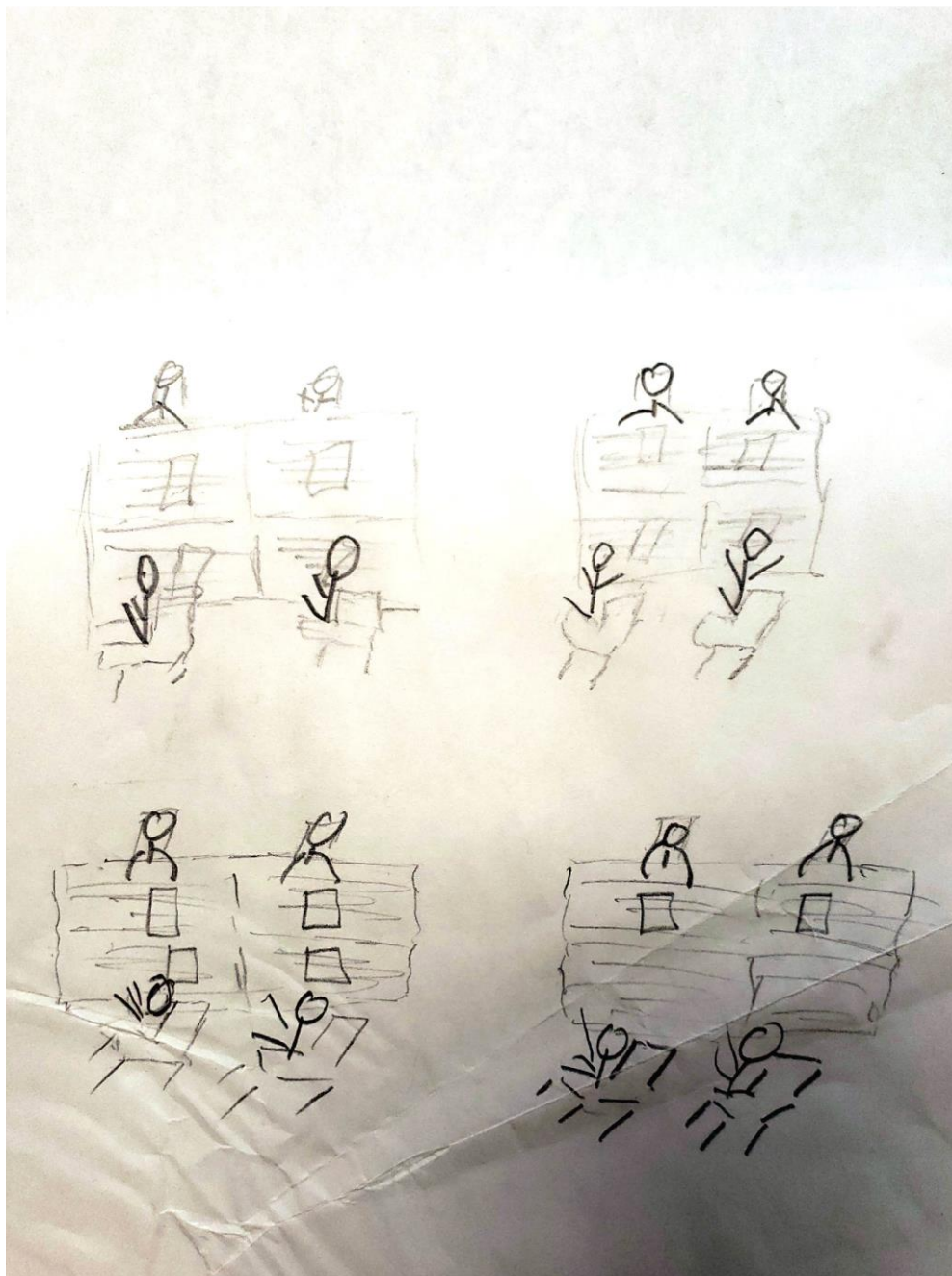
Appendix J – Benjamin's Drawing of First Prompt

"Think about the kinds of work and activities you do in the classroom. Draw a picture of how a camera will see you when you are learning mathematics in the classroom."

Appendix K – Benjamin's Drawing of Second Prompt

"Think about the kinds of supports that you need to be successful in learning mathematics. Draw a picture about an imaginary classroom in which you are provided unlimited kinds of features that will help you learn."
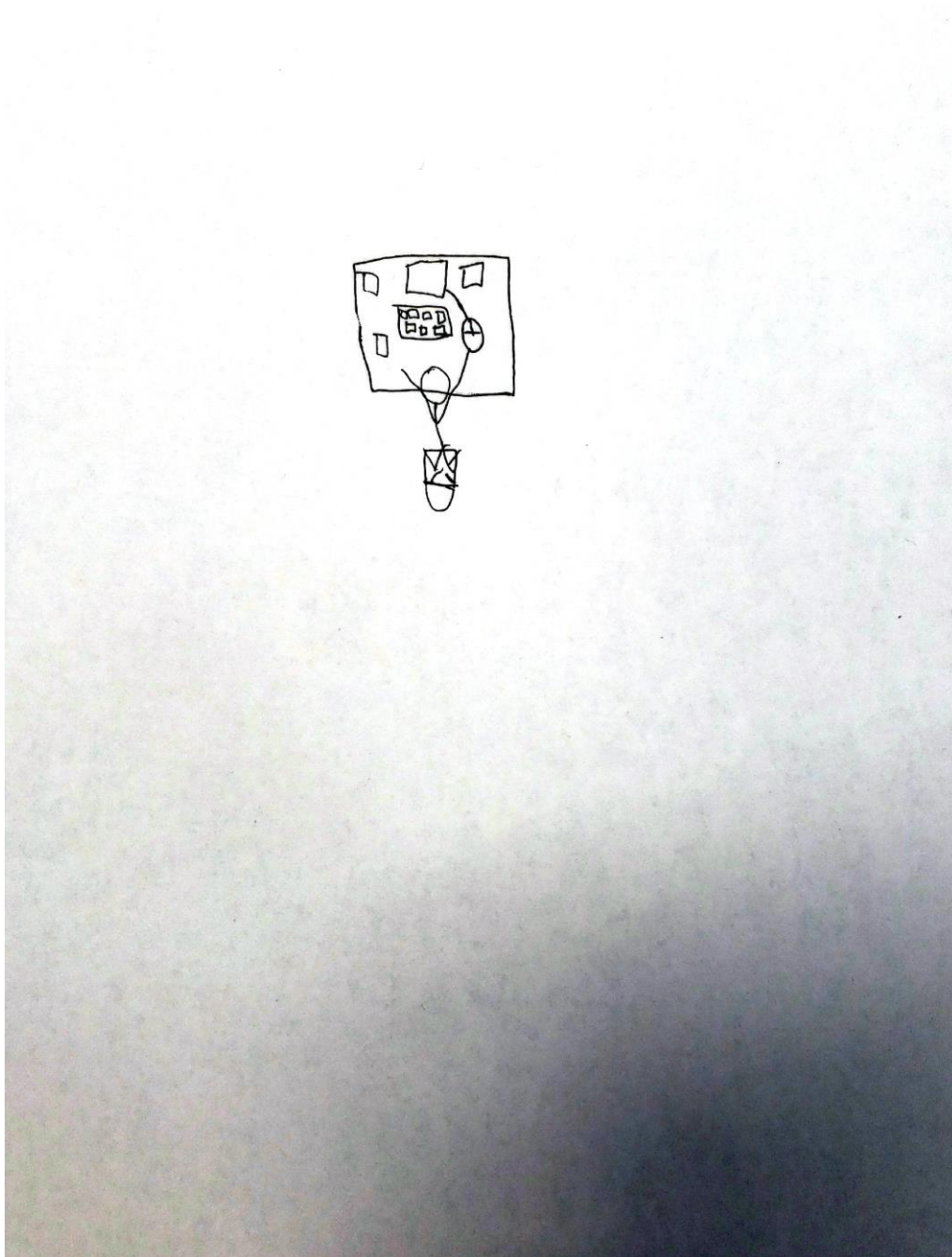
Appendix L – Caleb's Drawing of First Prompt

"Think about the kinds of work and activities you do in the classroom. Draw a picture of how a camera will see you when you are learning mathematics in the classroom."
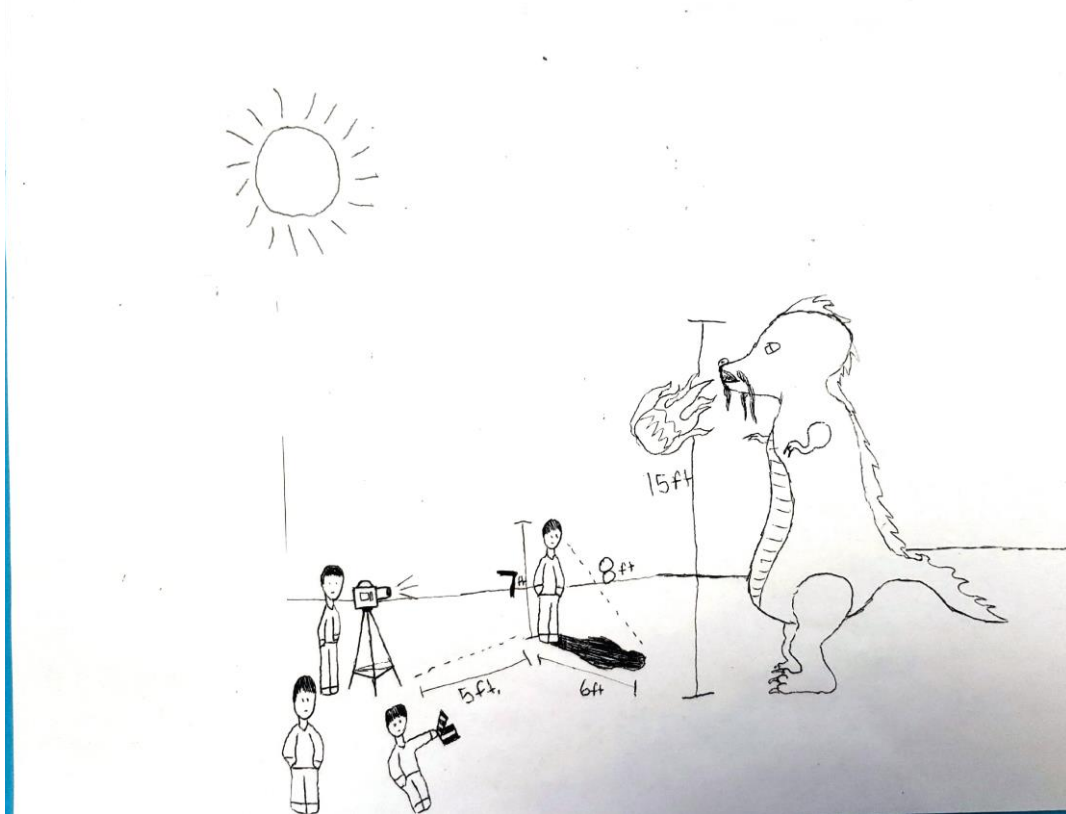
Appendix M – Caleb's Drawing of Second Prompt

"Think about the kinds of supports that you need to be successful in learning mathematics. Draw a picture about an imaginary classroom in which you are provided unlimited kinds of features that will help you learn."
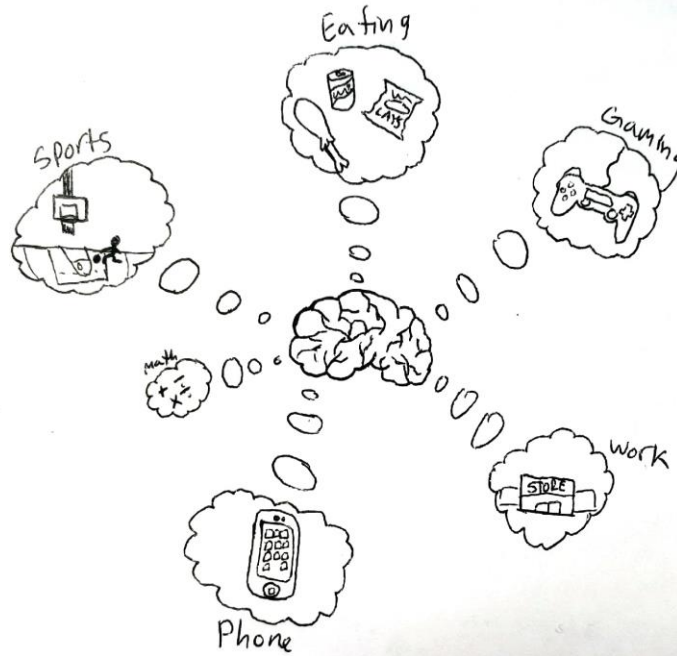
Appendix N – Daniel's First Drawing of First Prompt

"Think about the kinds of work and activities you do in the classroom. Draw a picture of how a camera will see you when you are learning mathematics in the classroom."

Appendix O – Daniel's Second Drawing of First Prompt

"Think about the kinds of work and activities you do in the classroom. Draw a picture of how a camera will see you when you are learning mathematics in the classroom."
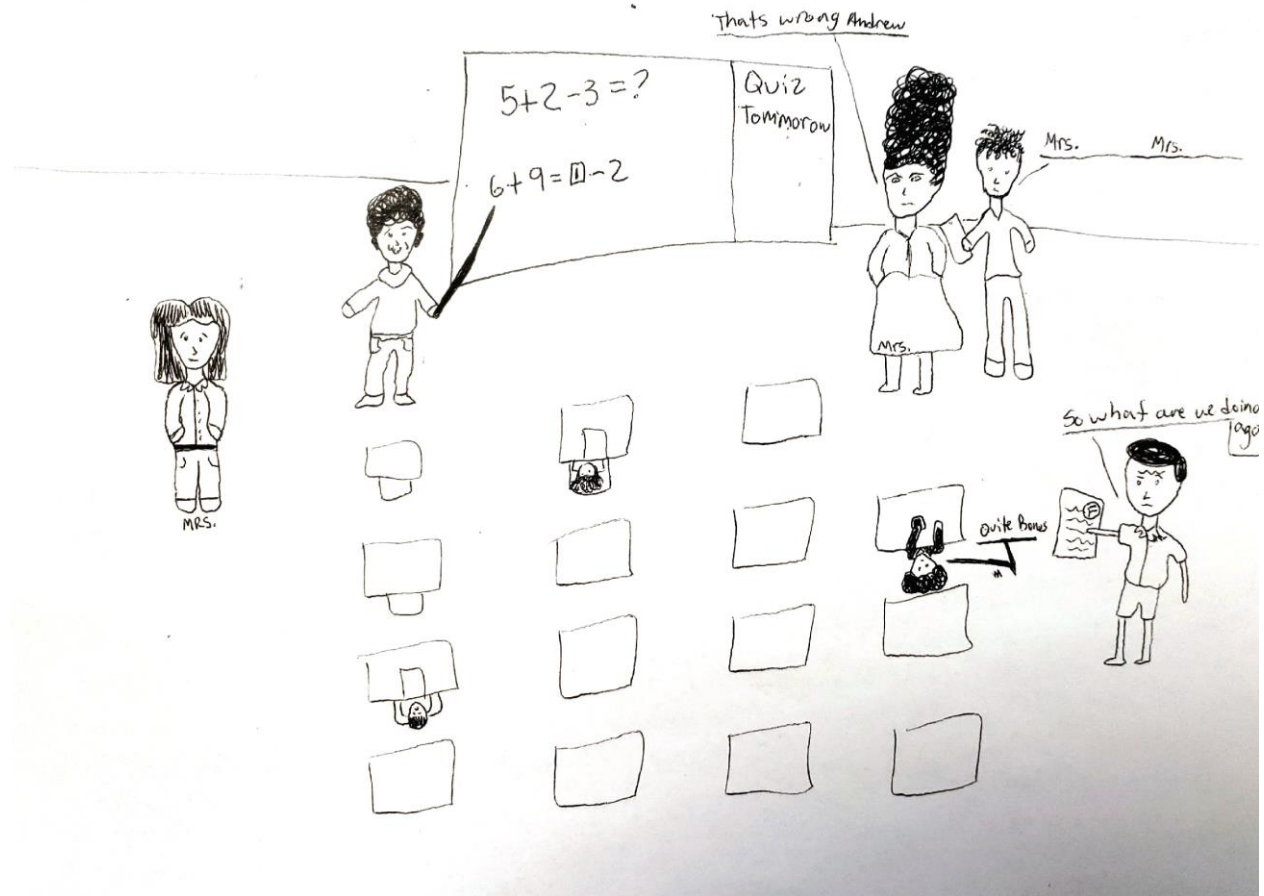
Appendix P – Daniel's Third Drawing of First Prompt

"Think about the kinds of work and activities you do in the classroom. Draw a picture of how a camera will see you when you are learning mathematics in the classroom."
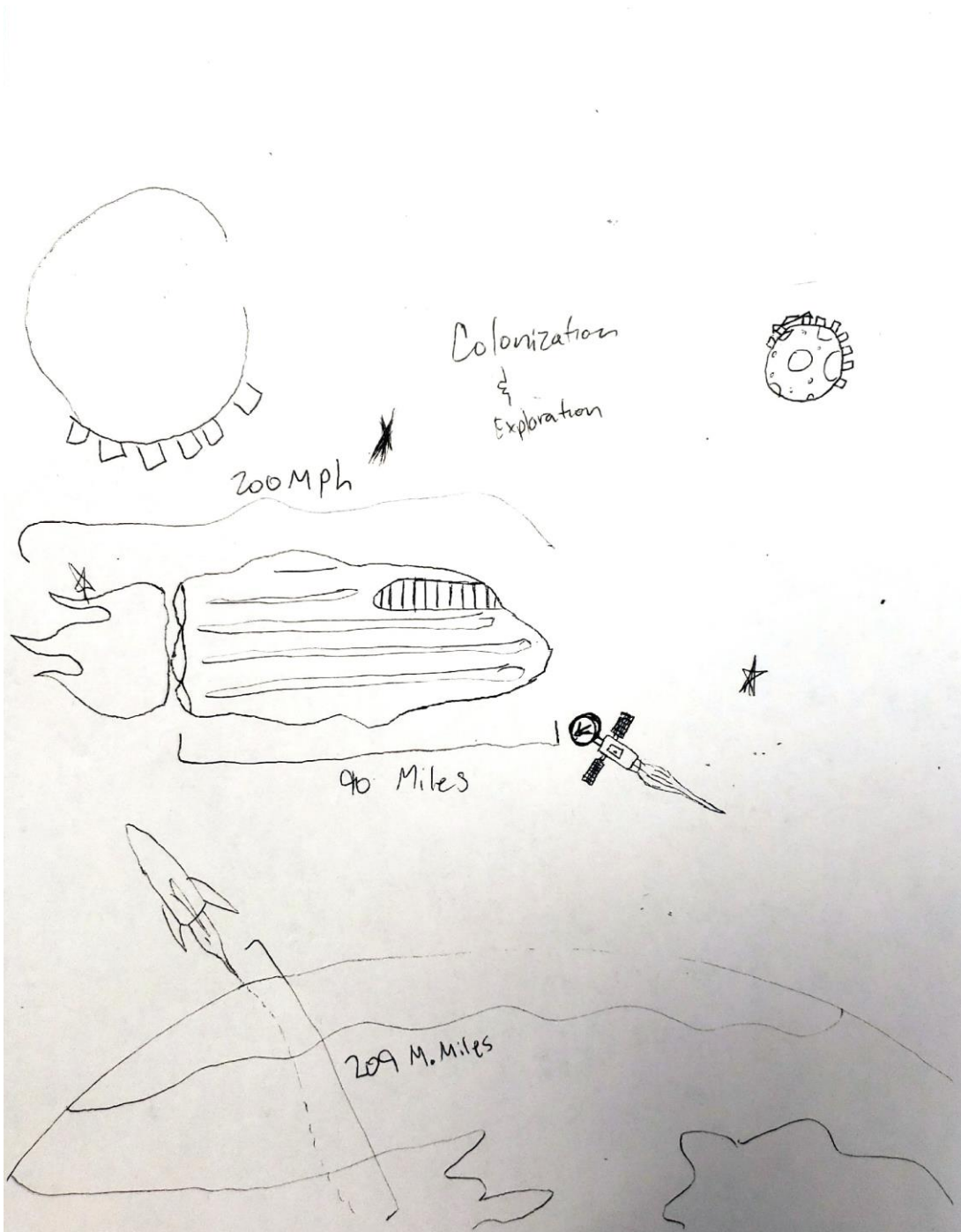
Appendix Q – Daniel's Drawing of Second Prompt

"Think about the kinds of supports that you need to be successful in learning mathematics. Draw a picture about an imaginary classroom in which you are provided unlimited kinds of features that will help you learn."

Appendix R – Exceptionality and Test Scores Data

Table 7

Students' exceptionality data and relevant test scores collected through document review

Name / Category	Armando	Benjamin	Caleb		Daniel
Exceptionality	English Language Learner (ELL) & Learning Disability (LD)	Autism Spectrum Disorder (ASD) & Gifted	Autism Spectrum Disorder (ASD)		Attention Deficit Hyperactive Disorder (ADHD)
Age/Grade of diagnosis	Disability: ▪ ELL program: primary grades to present ▪ Psychology evaluation completed: 10 years (5th grade)	Disability: ▪ preschool diagnosis of Significant Development Delay (SDD) + speech ▪ 6th grade eligibility of Autism Spectrum Disorder ▪ Gifted program: 8th grade ▪ Psychology evaluation completed: 8 years (3rd grade)	Disability: ▪ preschool diagnosis of Significant Development Delay (SDD) + speech (4 years) ▪ received a medical diagnosis of Attention Deficit Hyperactive Disorder ▪ in kindergarten the eligibility changed to Emotional Behavior Disorder and continued till 6th grade ▪ re-tested during 6th grade (11 years) with a change of eligibility to Autism Spectrum Disorder		Disability: ▪ 11 years (5th grade) ▪ has a medical diagnosis of Attention Deficit Hyperactive Disorder
Ability test used	Differential Ability Scales in Spanish	Reynolds Intellectual Assessment Scale	Differential Ability Scale (preschool)	Wechsler Intelligence Scale (6th grade)	Wechsler Intelligence Scale
General mental ability Verbal score Quantitative Non-verbal score	Below average 70 NA 81 86-spatial cluster	Below Average 92 NA 82 Note: His scores on academic achievement were higher than indicated ability level.	Below Average 72 NA 79 76-spatial cluster	Average 108 NA NA 102-perceptual reasoning Note: Academic achievement scores were all average.	Low Average 95 NA NA 98-perceptual reasoning Note: Scores in academic achievement are average. Written expression was a problem and math concepts and applications a high.
Notable weaknesses	Verbal reasoning (difficulties in word math problems) Long-term retrieval Processing speed Cognitive fluency	Short term memory; difficulties with changes in routines; taking turns in group work; has a very concrete way of interpreting information and has sensory needs.	Displayed aggressive behaviors; does not comply with directions	Focus on details at the exclusion of the whole; has trouble coming up with alternative ways to solve problems; communication and social skills.	Relative in short term visual memory; difficulties in written expression; ADHD behaviors observed more at home than at school.
Notable strengths	Pseudoword coding Math calculation	None noted	Pictorial measure of nonverbal reading and conceptualization	Responds better to cognitive demands	None reported
Deficits Expected to affect the following academic areas	Mathematics reasoning	Sentence writing when the demands were very open-ended; social skills; literal interpretation; does not	Behavior interferes with his classroom functioning, relationships, and socio-emotional development	Struggles with communication and social skills (not observed at home); perseveres on preferred	Inattention impact on performance

		change behavior to match the environment.		topics and did not engage with peers – he preferred to read a book.
Class Rank	569/708	229/708	388/708	632/708
Standardized:				
9th Algebra	59	80	73	74
Geometry	60	85	81	76
9th Lit	71	84	81	69
American Lit	NA	93	72	65
Biology	53	91	82	78
US History	66	NA	89	NA

Note:
1. NA indicates that students did not take yet the EOC for that specific class.
2. Standardized test scores impact graduation indirectly through its weight into the class average (it counts 20% of the classroom grade).