2019

The perceived appeal, challenge, and learning choice for gifted and talented students in advanced placement mathematics courses

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THE PERCEIVED APPEAL, CHALLENGE, AND LEARNING CHOICE FOR GIFTED AND TALENTED STUDENTS IN ADVANCED PLACEMENT MATHEMATICS COURSES

A dissertation submitted in partial satisfaction

of the requirements for the degree of

Doctor of Education in Leadership, Administration, and Policy

By

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December, 2019

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ACKNOWLEDGEMENTS

Carpe Diem!

It is always appropriate to seize the day and learn everything you can. I learned this saying long ago in high school and have tried to live its mantra every day.

To my husband, who knew that the journey to match your two Masters degrees would lead me to leap frog your accomplishments and reach this level? Together through the Master and Doctorate processes we have learned how to balance life, children, jobs, and housework. If only we could figure out how to make our children get along on a daily basis. I do thank you for your constant support and the nagging I needed to get this dissertation done. Is the Ed.D. abbreviation after my name better than another baby?

To my children Jack and Tara, thank you for making me want to be a better teacher, role model, and person. The day I became your mother I knew that I really needed to live each day to its fullest and enjoy all the moments including the soccer wins, the stage performances, and the educational victories. May my love of learning continue to be an inspiration to you. Don't forget to always DREAM BIG.

To my family, friends, and co-workers, thank you for always asking about my educational journey and being a constant source of support and encouragement. You have held me up and pushed me forward day after day. Mom, this journey and race of degrees has been a constant source of humor. Dad, I am thankful for all your years of proof reading my papers, and so glad that all that training growing up meant I could do this one on my own. Kerry, thank you for taking my kids off my hands when I needed to write or study.

To Dr. Leigh, thank you answering my many emails and all my questions. Without you, I would have been lost in much of the statistics (even with my mathematics background). Thank you Dr.Webb for your thorough review of every paper I wrote and always laughing. Dr. Collatos, thank you for believing in my research and pushing me to dig deeper. Thank you to all the Pepperdine faculty who have supported me over the last five years, including Dr. Lund who encouraged me to even apply for a doctorate program when it was not on my radar.

To the Perfect Ten, thank you for being on this journey with me. Thank you for the countless text messages, video chats, phone calls, tears, and laughs. I gained many great friendships through this process with you. I am so excited to see where our journeys take us.

Without the support of each of you, I would never have truly seized the day and I truly hope that every educator works to have every child bloom to their fullest potential.

VITA

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ABSTRACT

The Advanced Placement program has undergone many changes since its post Sputnik surge when it was designed to accelerate learners. The number of students enrolled in AP courses has swelled, demographics of participants have diversified, and course curriculums and designs have altered. The homogenous Ivy League bound population of gifted and talented students who made up the initial 1,299 students enrolled in the program has morphed into a heterogeneous population of over 2,800,000 students with many learning needs. With the increase in the testing culture of the United States, the focus in education has shifted towards closing the achievement gap with teachers focusing on the low-performing learners. To address the data results, many schools are using Response to Intervention to improve student outcomes and provide equity of educational experiences. For equitable experiences, previously identified gifted and talented students require courses which appeal to them, provide challenges through depth and complexity, and offer choice in the learning and products produced.

In this quantitative, comparative, quasi-experimental study, a multivariate analysis of variance was used to investigate the perceptions of Advanced Placement mathematics students previously identified as gifted and talented in relation to a matched group of their non-identified peers with regard to the concepts of appeal, challenge, and learning choice. The population for this study consisted of 271 high school students enrolled in either Advanced Placement Calculus AB, Calculus BC, or Statistics in 3 high schools in 1 Southern California school district. Data was gathered via an electronic survey with 24 Likert-scale questions, with 21 questions from the Students Perceptions of Classroom Quality Survey. Demographic data was gathered from participants for matching. A MANOVA data analysis resulted in statistically non-significant differences between the two populations in regards to their perceptions, thus failing to reject the

null hypothesis. The AP program may be an equalizing educational program. However, the resulting descriptive statistics showed mean value responses lower for the previously identified gifted and talented students in comparison to their non-identified peers for each variable. These differences suggest that educational equity of outcomes and participation may not exist in AP mathematics classes.

Chapter 1: Introduction

In 1958, The Rockefeller Panel Reports (Rockefeller Brothers Fund, 1961) recognized little attention had been given to those students identified as gifted and talented in educational institutions, and instead a focus persisted in raising the overall average level of achievement. Gifted individuals, however, greatly impact the world with their inventions and abilities and are the least likely group of individuals to learn and achieve their potential (Cardillo, 2010; Heim, 1998). If the talents of the gifted are not fostered, and talented students are not encouraged to develop and use their gifts, those students are not receiving a strong and successful educational experience (Bish, 1958). For all students to find success, academic excellence must be the focus of schools (Oakes, 1986).

Background of the Study

The launch of Sputnik in 1957 reformed the United States educational system with a push towards an organized effort of intellectual improvement in math, science, and foreign language curriculum, as well as an increase in the college-going culture (Coleman, 1999; Cross, 1999; Haensly, 1999; Imbeau, 1999; Loveless, Farkas, & Duffet, 2008; Mollison, 2006; Rehm, 2014; Rockefeller Brothers Fund, 1961; Siemer, 2009; Stewart, 1999; VanTassel, 2018). Prior to the Sputnik launch, the Ford Foundation created the Fund for the Advancement of Education in 1951, which through its investigation found repetition in the material students learned in high school and the first years of college (Rothschild, 1999; Zarate & Pachon, 2006). The School and College Study of Admission with Advanced Standing Organization, also funded by the Ford Foundation, along with Kenyon College, spurred the Ford Foundation's creation of the Advanced Placement (AP) program in 1953 (Clark, Moore, & Slate, 2012; Nugent & Karnes, 2002; Rothschild, 1999). Students engaged in the program would enter college with advanced

standing, eliminating a duplication of effort by colleges and decreasing the amount of time wasted by students. However, the program was promoted for only an elite small group of exceptional high school students (Arbolino, 1961, 1964; Colangelo, Assouline, Gross, & Iowa University, 2004; Freedman & Krugman, 2001; Rehm, 2014; Rothschild, 1999). AP programs, though, were only present in America's most elite public and private schools at the time, from which graduates commonly matriculated on to Ivy League schools such as Harvard, Yale, and Princeton (Arbolino, 1961; McCammon, 2018; Nugent & Karnes, 2002). The first AP exams were administered by the College Board in 1956 and included 11 subject areas: mathematics, chemistry, biology, physics, English, American history, German, Latin IV, Latin V, Spanish, and French (Mollison, 2006).

The 1981 and 1983 *A Nation at Risk* publications by the National Commission on Excellence in Education spurred a movement to bring AP courses to more schools for the high achieving population of students (Rehm, 2014; Rothschild, 1999; Russo; 2001). In the 1990s the culture began to shift again, describing students who should enroll in AP courses as "highly motivated and seriously committed" (Rehm, 2014, p. 83) and provide opportunities for all students that promote self-direction (Colwell, 1990). The notoriety of Jaime Escalante and his exceptional work and commitment to the inner-city students at Garfield High School and their subsequent success on the AP Calculus exam created a culture shift towards equity of access to AP courses (Mathews, 1982; Rehm, 2014). Two court cases in the late 1990s, *Daniel et al. v. State of California* (1999) and *Castaneda et al. v. University of California Regents* (1999) highlighted the student and parental mindset change where communities were now fighting for equity of access to AP exams and courses, while also fighting the admissions processes at

universities based on completion of AP coursework (Solórzano & Orenelas, 2002). Open access to Advanced Placement courses was gaining strength in the American population.

In 2001, President Bush signed into law the No Child Left Behind (NCLB) Act to help close the achievement gap by establishing more accountability for schools and combining equity and excellence into one program (Loveless et al., 2008). Bi-products of this law included open enrollment or access to AP courses, as well as not listing gifted students as a significant subgroup in data collection on state level assessments leading to neglect of high achievers (Kraeger, 2015; Loveless et al., 2008; Rehm, 2014; VanTassel-Baska, 2018). These changes have led to a focus on struggling learners, and a possible neglect of high achievers (Loveless et al., 2008).

In 1956 when the first AP exams were given, 1,229 students participated in the AP program taking 2,199 exams (College Board, 2018a). By the 2017-2018 school year, 2,808,990 students were participating taking 5,090,324 exams for an increase of 228,459% in the number of students and 231,384% in exams taken since the beginning of the program (College Board, 2018a). Therefore, with the addition of so many students over the past 60 years since the creation of AP courses, the students enrolled in these courses have transitioned from a homogenous population of exceptional students from elite schools which fed into Ivy League universities to a heterogeneous population of students with varying levels of skill and talents (Mollison, 2006).

Gifted and Talented (GT) students are described by the California Department of Education (*Gifted and Talented Education Program Resource Guide,* 2005) as demonstrating high capability and achievement in academic areas as observed by the teacher and principal, which in many school districts is done through some form of standardized assessment. The

California Codes still used in identifying GT students, specifically recognizes intellectual, creative, specific academic, and leadership abilities, along with high achievement and visual and performing arts talent (CA Code Regs. Title 5, §3822). These California Codes were repealed in 2014 when the Local Control Funding Formula (LCFF) was approved through legislation. The line item that was in previous school district budgets for Gifted and Talented Education (GATE) was removed and instead funds for GATE are included in a single block grant for many categorial programs. School districts than create a spending plan at the local level to decide if they want to fund GATE programs. There exists no requirement of maintenance of effort, or consistent funding rules that schools must by law adhere to, in regards to GT funding, as there is for Special Education programs.

Nationally, the identification of GT learners focuses on the academic and intellectual abilities of the students with a focus on standardized achievement (Hodges, Tay, Maeda, & Gentry, 2018). The procedures for identifying GT students are typically decided at the district level, and usually encompass three phases: nomination, screening, and selection (Johnson, 2009). Some districts in California focus on GATE testing between second and fifth grade with universal screening with the Otis Lennon School Ability Test (OLSAT), Naglieri Nonverbal Ability Test (NNAT3), Cognitive Abilities Test Screener (CogAT), and the results from the Smarter Balanced Assessments ("Curriculum: GATE identification," 2018-2019; "GATE Testing and Identification," n.d.; "Gifted and Talented Education," n.d.; "Gifted and Talented Education (GATE)," n.d., "Identification, Support, & FAQ," n.d.). Other districts report that a search and referral process, followed by screening, and then committee review of academic abilities, intellectual assessment, audition, or demonstration of talent ("GATE Identification Process," n.d.).

Once students are identified as GT, school districts must then decide how to meet the needs of this special population. At the elementary level of schooling, the most commonly used model to differentiate for the GT students is cluster classrooms or resource rooms, while at the middle school level GT students are offered advanced coursework or honors courses (Callahan, Moon, & Oh, 2014; National Association for Gifted Children, 2015; Sapon-Shevin, 1994). The National Research Center on the Gifted and Talented report that high schools primarily use Advanced Placement courses as the curricula for GT students (*Gifted and Talented Education Program Resource Guide*, 2005).

Researchers suggest that not all gifted students possess the same qualities and therefore homogenous groupings do not satisfy each individual student's needs (Brown, 2012; Park & Oliver, 2009; Schmitt & Goebel, 2015). Graffam (2006) conducted a case study which reviewed the practices of two teachers of homogenous gifted programs and found that teachers of advanced students must alter both the individual curriculum and the whole-group learning while at the same time discover ways to differentiate, compact and accelerate as needed. However, the College Board, which created the curriculum outlines for AP courses, advocates for open enrollment to "all willing and academically prepared students" (College Board, 2012a, p. 28) and for closing the achievement gap for these courses resulting in classrooms with a diversity of abilities (College Board, 2014). The College Board does not direct AP teachers to differentiate instruction to meet the needs of the all students in open-enrolled heterogeneous AP classrooms, nor does it dictate which techniques to use with the GT population.

AP teachers whose classrooms include GT students have many barriers to overcome to meet the needs of each student. Barriers for teachers include the ability to provide advanced learning opportunities beyond the grade level of student, the lack of understanding of services for

gifted students, the degree of differentiation required, and the pressure to raise overall classroom test scores (VanTassel-Baska & Stambaugh, 2005; Westberg & Daoust, 2003). However, if educators do not find ways for GT students to be challenged, gifted students who begin their educational career scoring in the top quintile on standardized tests may regress towards normal levels of achievement (VanTassel-Baska & Stambaugh, 2005).

Loveless et al. (2008) found that NCLB narrowed the achievement gap between high and low-achieving students because low-achieving students' gains in tests scores were two or three times higher than their high-achieving counterparts. For these high-achieving GT students to continue to excel in AP classrooms, educators must use differentiation strategies to meet the needs of this population (Seedorf, 2011; VanTassel-Baska & Stambaugh, 2005), yet even with professional development, little differentiation is occurring (Callahan et al., 2014; Westberg & Daoust, 2003)

At the forefront of public education currently is the Response to Intervention (RtI) model, which encourages differentiation for all learners through its three tiers including classroom differentiation, additional workshops or interventions outside of regular class time, and for intensive small-group targeted instruction. However, with a drive to close the achievement gap and attain high test scores, the focus tends to be on the struggling learners and not the GT (Brighton, Hertberg, Moon, Tomlinson, & Callahan, 2005; Loveless et al., 2008). Currently, approximately 1.5 million students nationally require more rigorous instruction than the current state standards detail, about 10 to 20% of the students who drop out of high school are GT, and 40% of GT could be labeled as underachievers (Davidson Institute for Talent Development, 2006).

For GT learners to achieve at high levels, their coursework needs to appeal to them, provide the correct amount of challenge, and provide choice in the learning. Appeal in the content is found through connections to personal interests and enjoyment in the learning process (Gentry & Owen, 2004). Challenge is created by the instructional techniques utilized by the teacher and the tasks students are asked to complete (Davidson, Davidson, & Vanderkam, 2004; Gentry & Springer, 2002; Gentry & Owen, 2004; Krist, 1999). Using the concepts of depth and complexity, teachers can embed challenge through grade-level content by having GT students research further into a concept or provide an open-ended situation for discovery. Learning choice closely follows challenge in that the instruction provides the student choices in the product, process, and even the content that hopefully challenges students in the course (Beasley & Beck, 2017; Gentry & Owen, 2004; Kaplan, 2008; Kaplan, McComas & Manzone, 2016; Tredick, 2009). Through these constructs, GT students find more motivation and engagement in learning.

Gifted and talented students are regressing in their achievement (Davidson Institute for Talent Development, 2006; Heim, 1998). This regression may be the product of AP classroom populations increasing in diversity nationally within the secondary student population (Rehm, 2014) or with AP courses becoming the defacto curriculum for the education of GT in high schools (*Gifted and Talented Education Program Resource Guide*, 2005). The weakening levels of achievement may be the result of the impact of the testing culture of schools and teachers being less prepared to address the needs of GT students (VanTassel-Baska & Stambaugh, 2005) and focusing their attention on the struggling learners (Loveless et al., 2008; Seedorf, 2011). Ultimately, GT students deserve to reach their highest potential, just as the struggling learner does.

Statement of the Problem

It is known that the AP population is increasing in diversity nationally within the secondary student population. It is also noted that classrooms are being impacted by the testing culture of schools where the focus is on improving learning for the struggling students and not the gifted (Loveless et al., 2008; Seedorf, 2011). Additionally, it is recognized that teachers are less prepared to address the needs of gifted students than the struggling learners (Hertberg-Davis, Callahan, & Kyburg, 2006; VanTassel-Baska & Stambaugh, 2005). It is also published that for every year a gifted student remains in a non-enriching classroom that a year of intellectual capability is lost, as shown in test scores (Davidson et al., 2004).

The College Board provides a framework for the content covered in AP courses and ultimately in the preparation of students for the cumulative AP exam in May each year. Even though teachers must submit their AP course syllabus for College Board approval, what remains unknown is how, if at all, instructional content is differentiated for GT students in AP mathematics classes to meet their individual needs or if AP classes and exams are the appropriate vehicle for differentiated instruction for GT students. Therefore, there is a need to look into the factors that may lead to the regression in test scores for GT students over their educational experience.

Studies have been conducted on teachers' perceptions of GT students and differentiating learning to meet their needs (Abu Hassoun, 2015; Ayebo, 2010; Daugherty, 2010; Kern 2012; Marotta-Garcia, 2011; Norris, 2013; Palladino, 2008, Poli, 2018; Reilly, 2014) and on the Advanced Placement programs (Clark, Moore, & Slate; 2012; Geddes, 2010; Hertberg-Davis, Callahan, & Kyburg, 2006; Hertberg-Davis, & Callahan, 2008; Rothschild, 1999). Clark, Moore, and Slate (2012) found that no data exists that specifically showed if GT students

benefited more or less than the non-identified GT peer in their AP courses. Hertberg-Davis and Callahan (2008) found that GT students felt appropriately challenged in AP classes, but not necessarily allowed choice, which is beneficial for all students including GT. Research is greatly lacking that has a comparison of the perspectives of GT students and their non-identified GT peers in the Advanced Placement mathematics programs focusing on the perceptions of appeal, challenge, and learning choice. Therefore, these AP courses, created initially to reduce the repetition of coursework between the last years of high school and the first years of high school, may not capture the interest of gifted students, challenge gifted students at a level consistent with their need, or offer opportunities for different products to showcase their learning.

Purpose of the Study

The purpose of this quantitative, comparative, quasi-experimental study was to identify what differences, if any, existed in the perceived appeal, challenge, and learning choice in high school Advanced Placement (AP) mathematics courses between AP students who were previously identified as GT versus a matched group of those who were not. To accomplish this purpose a survey was given to students currently enrolled in an AP Mathematics course near the end of the course requirements. The results were analyzed to explore if any differences existed between the two populations of students in these accelerated, college-level courses.

Research Question and Hypotheses

To what extent, if at all, do differences exist in perceptions of appeal, challenge and learning choice in high school AP mathematics courses between AP students who were previously identified as gifted and talented versus a matched group of those who were not?

Alternative hypothesis. The Advanced Placement programs began as a means to allow for early access to college but were not designed to meet the needs of GT students with the

current open access policy (Gallagher, 2009). These GT students typically identified in third grade are enrolling in college level courses some eight or nine years after identification. There is no requirement of being GT to enroll in AP courses, but in many school districts AP courses are the advised curriculum for schools to meet the needs of GT students (*Gifted and Talented Education Program Resource Guide*, 2005). The accelerated pathway offered in AP classes does provide one method of acceleration for the GT, but Kaplan (2009) argues that no single curriculum exists that meets the needs of each GT student. Kaplan (2009), instead, suggests particular differentiation strategies which when used in the classroom to teach content individualize the learning for the success of GT students.

AP Programs do provide an opportunity for students hungry for a challenge, and a break from the boredom riddled general education classrooms (Hertberg-Davis & Callahan, 2008). However, the AP courses can be non-ideal for GT students if AP teachers do not allow for flexible grouping, differentiated curriculum, and attention to the differences between each GT student (Van Tassel-Baska, 2001). It was therefore hypothesized that there was a significant difference in perceptions of appeal, challenge and learning choice in high school AP mathematics courses between AP students who were previously identified as GT versus those who were not. Gentry and Owen (2004), who designed the Student Perceptions of Classroom Quality (SPOCQ) instrument to be used in this study, predicated that students in AP courses would have higher scores on each of the variables than those in other non-advanced classes. However, they did not predict differences between gifted students and non-identified GT students enrolled in the same AP course.

Null hypothesis. There was no significant difference in perceptions of appeal, challenge and learning choice in high school AP mathematics courses between AP students who were previously identified as gifted and talented versus those who were not.

Theoretical Framework

Educational equity is about creating learning environments for students that are fair and promote excellence for all students. The 1954 U.S. Supreme Court decision in *Brown v. Board of Education of Topeka* on legality of desegregation began a journey towards equity of education (Brookover & Lezotte, 1981; The Learning Network, 2012). Educational equity theory focuses on making education equivalent for all students under three standards: access, participation, and outcomes (Brookover & Lezotte, 1981). The goal of this study was to understand the perceptions of students enrolled in AP classes to discover if the college-level course work was fulfilling their educational needs in terms of outcomes. Schools are instructed to allow all students, gifted or not, who are ready to engage in the rigor of Advanced Placement courses to offer enrollment in the courses, so access was not a concern in this study (AP Opportunity Program, n.d.). In actuality, some of these courses may experience over-enrollment due to expectations placed on students by counselors and parents, the boost to student grade point average, and the capitalization of the College Board and the branding the College Board has done in regards to the AP program and its other successful tests: SAT and SAT II. Being enrolled in a course, however, does not necessarily lead to equal participation or outcomes. Equal participation implies that the different needs of each student are met via interactions with the teacher, interactions between students in the classroom, opportunities to learn, or differentiated learning (Brookover & Lezotte, 1981). Equity outcomes do not imply that all

students perform at the same level, but that students perform at the highest level of their personal capacity (Bish, 1958; Brookover & Lezotte, 1981; Davidson et al., 2004).

The belief is that AP courses are the great equalizer in giving every student an opportunity to be successful (Colangelo et al., 2004). The College Board promotes their Advanced Placement program to various disaggregated groups: minorities, low SES, middle income, from rural backgrounds, with disabilities, from small schools, large schools, private schools, as well as students from other countries. With all the different backgrounds, AP courses can be seen as an equalizer which is shown via an identical test where students defend their knowledge of a designated amount of college level material no matter where they went to school, where they grew up, or their appearance (Colangelo, et al., 2004).

However, students are instructed in college level courses that are largely fast-paced, one-size-fits-all environments due to what some instructors feel is a large amount of material to cover in a short amount of time (Hertberg-Davis, Callahn, & Kyburg, 2006, p.v). Gifted children need curriculum that provides opportunities for exploration, matches their abilities, and challenges them at their level to be successful (Davidson et al., 2004). The 1958 Rockefeller Report on "The Pursuit of Excellence" (Rockefeller Brothers Fund, 1961) recognized that the educational system needed to provide sufficient attention and flexibility in policy and curriculum to meet the needs of students of varying levels of talent to create challenging and rigorous experiences. To achieve education equity, there is a need to create opportunities for each students' individual needs, whether those needs come from gifts, disabilities, social status, or race (Bish, 1958; Davidson et al., 2004). These needs may be met by modifying the instruction through differentiation strategies or providing additional supports to students as needed (Hertberg-Davis et al., 2006).

Definition of Terms

Acceleration. An education intervention in which students are progressed through schooling at a faster pace than their age level peers (Assouline, Colangelo, VanTassel-Baska, & Lupkowski-Shoplik, 2015; Steenbergen-Hu & Moon, 2011).

Advanced Placement (AP). High school courses that are rigorous, college-level classes offered in a variety of subjects that give students an opportunity to gain the skills and experience that some colleges recognize in the form of course credit (Rehm, 2014).

Common Formative Assessments (CFAs). An assessment created by a group of teachers in the same course. CFAs are commonly used to identify students who need instructional support, to identify the most successful teaching strategies, to identify whole classroom areas of difficulty, and to create goals for teachers (DuFour, DuFour, Eaker, & Many, 2006).

Differentiation. Tailoring instructional practices to meet the needs of each individual student through variations in content, process, and product to respond to the curious and creative needs of the learner (Beasley & Beck, 2017; Kaplan, 2008; Kaplan, McComas & Manzone, 2016; Tredick, 2009).

Essential skills. The necessary knowledge or proficiencies students are expected to know or perform at the end of a course (DuFour et al., 2006).

Professional Learning Community (PLC). A group of educators who work together through collective inquiry, action research, and job-embedded learning to accomplish better results for the students they teach (DuFour, DuFour, & Eaker, 2008).

Response to Intervention (RtI). A three-tiered system dedicated to offering increased levels of support to students (see Figure 1). The core curriculum (Tier 1) is delivered to all

students while those who require more receive additional support with increasing levels of intervention (Tier 2 or Tier 3) in addition to grade level instruction (Allain & Eberhardt, 2011).

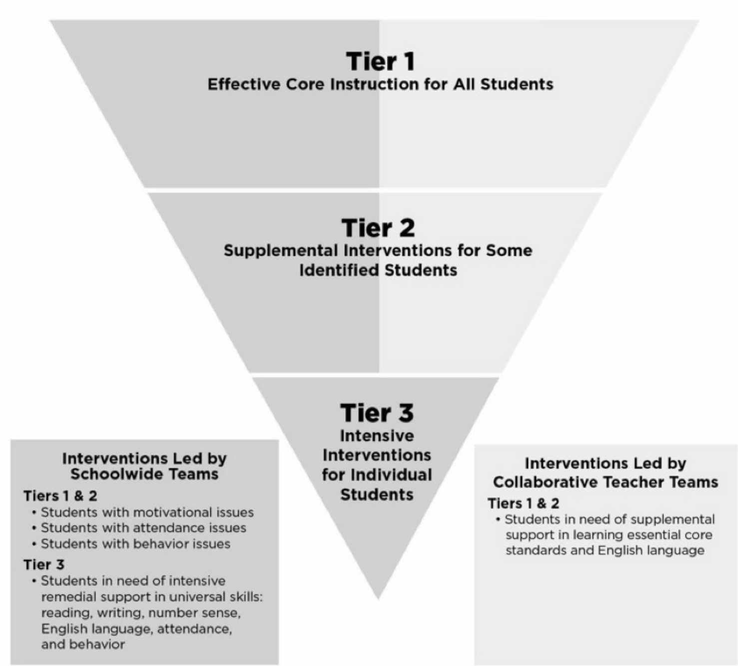


Figure 1. The Response to Intervention Pyramid (Buffum, Mattos, & Weber, 2012, p. 13) Used with permission. From *Simplifying Response to Intervention: Four Essential Guiding Principles* by Austin Buffum, Mike Mattos, and Chris Weber. Copyright 2012 by Solution Tree Press, 555 North Morton Street, Bloomington, IN 47404, 800.733.6786, SolutionTree.com. All rights reserved.

Operational Definitions

Appeal. Students' interest and enjoyment of the course, while also reflecting the safe, satisfying, and engaging classroom environment (Gentry & Owen, 2004). The variable will be measured using responses by participants on a 5-point Likert-scale from 1 = *Strongly Disagree* to 5 = *Strongly Agree* using the Student Perceptions of Classroom Quality (SPOCQ) instrument (see Appendix A).

Challenge. Students participating in effective learning involving depth, complexity, rigor while examining math content, processes, and products (Gentry & Owen, 2004). The variable will be measured using responses by participants on a 5-point Likert-scale from 1 = Strongly

disagree to 5 = Strongly Agree using the Student Perceptions of Classroom Quality (SPOCQ) instrument (see Appendix A).

Gifted and Talented (GT). Students who demonstrate high capability and achievement in academic areas as observed by the teacher and principal (*Gifted and Talented Education Program Resource Guide*, 2005). Gifted refers to students whose performance in academic subjects is ahead of their peers, while talented refers to students who have great ability in music, performing arts, art and design, sports or leadership (Goodhew, 2009). Also referred to as gifted, highly capable students, exceptional students, and learner of high-ability in different state definitions (Russo, 2001). In this study, students self-identified in the demographic data they supplied as GT based on the designation determined by their school site using a standardized assessment. Students in this study were not classified as GT in a specific domain, but given an overall GT designation.

Learning choice. Students leading decisions about their learning to take ownership and increase motivation (Gentry & Owen, 2004). The variable will be measured using responses by participants on a 5-point Likert-scale from 1 = Strongly disagree to 5 = Strongly Agree using the Student Perceptions of Classroom Quality (SPOCQ) instrument (see Appendix A).

Non-identified as gifted and talented. Students who are not previously identified as gifted and talented by their schools. In this study, students who did not self-identify as GT in the demographic data they supplied will be known as non-identified gifted and talented or non-identified GT.

Importance of the Study

It is hoped that the results from this study will truthfully depict the perceptions of GT students and their non-identified gifted peers in relation to their experiences in their Advanced

Placement mathematics course(s). Additionally, the information amassed in this study is hoped to add to the body of literature around the needs of GT students. Furthermore, the evidence gathered in this study adds to the body of knowledge regarding the Advanced Placement program. The evidence gathered in this study may assist educators of GT students in AP mathematics courses and the College Board in designing courses and instructional strategies to meet the specific needs of GT learners leading to equity of outcomes and participation in their classrooms for all students to be able to reach their highest potential.

Currently, in education, there exist initiatives to support all students to be successful in learning at high levels through models like Response to Intervention (RtI) and its three tiers of support (Buffum et al., 2012), as outlined below. With the RtI pyramid of interventions, teachers work to develop responses to assist struggling students and enrich the learning of advanced or GT students. The RtI model includes the following three tiers of intervention (See Figure 1). The Tier 1 component of this successful strategy should allow for 80% of students to reach success through classroom instruction only (Shapiro, n.d.). Tier 1 involves differentiated classroom instruction to meet the needs of individual students and defines positive behaviors for effort, attendance and social behaviors for students to demonstrate. Fifteen percent of students receive Tier 2 interventions providing opportunities for small group meetings with students on targeted areas of content or behavior to advance or support students (Allain & Eberhardt, 2011). For example, a student may receive additional instruction from their mathematics teacher on adding and subtracting integers to assist in solving an equation. Tier 3 instruction is for the smallest group of students, about 5% of the population, who are students with exceptionalities (Allain & Eberhardt, 2011). For GT, these Tier 2 and Tier 3 methods may include advanced coursework, extension of learning or enrichment (Buffum et al., 2012). Therefore,

implementation of a successful intervention system requires planning for every level of response, so all students reach their goals, with a particular focus on reaching the majority of students during Tier 1 classroom intervention time, including providing lessons that are enriching for GT students. During a previous participatory action research project, the researcher discovered that teachers in the school of the research project struggled most with how to meet the needs of GT students in the RtI structure.

Raising test scores and closing the achievement gap have been at the forefront of education since the introduction of No Child Left Behind (NCLB) legislation and continue with the re-authorization of the Every Student Succeeds Act (ESSA) signed by President Obama in 2015 (Johnston & Viadero, 2000; Norris, 2013), but the need is for all students to reach their highest potential. Results from this study provide evidence of a need to change classroom practices in AP mathematics classrooms to meet the needs of GT students and allow all students to reach their highest potential, not just raise the achievement of struggling students. As a result of this study, the College Board may need to revise their course frameworks, and policy changes at the local, state and federal level may need to be addressed to include additional funding for GT students in secondary education or differentiation mandates similar to those services special education students receive.

Limitations and Assumptions

This study had several limitations to consider. This study was limited to one public school district in Southern California limiting the generalizability of the findings to other schools and districts throughout the state, country and world where students engage in AP mathematics courses. The study's participants were high school students enrolled in Advanced Placement Mathematics courses, thus the findings may not generalize to non-AP mathematics courses.

Additionally, collection of data occurred near the end of coursework, so students may not have experienced all elements of the curriculum prior to collection of data. Due to the data collection occurring prior to end of the school year, scores that these students received on the AP math exam for their enrolled course and their second semester grades were not available as part of the data, but first semester grades were available. Furthermore, during administration of the survey, students self-identified as previously identified as GT.

The delimitations applied by the researcher in this study were developed to gain a better understanding of the perceptions of GT students in AP courses. Therefore, this study did not include the perceptions of the educators who work with the respondents. This study was only conducted in four public high schools in one school district in Southern California. Therefore, the researcher was unable to gain the perspectives of students enrolled in private or charter schools. To narrow the perspective, the study only examined perceptions in the AP mathematics courses of AP Calculus AB, AP Calculus BC, and AP Statistics. Due to the nature of identification processes in the secondary school district where this study was conducted, the research was limited to those previously identified as GT in primarily the third to fifth grade for that is when students are identified as GT in this school district.

This quantitative study assumed that the students who responded to the survey accurately represented their assumptions, understood the statements in which they responded, and accurately designated their status as GT or not. In order to ease the assumptions, the researcher used a digital survey stressing the aspects of anonymity and confidentiality. It was assumed that a sufficient number of parents would consent to recruitment of their children, and that those minors would assent and actually participate in the study in numbers sufficiently large across both groups to complete the planned statistical analyses.

Organization of the Study

This quantitative study is separated into five chapters. Chapter one provides background on the Advanced Placement program and the needs of GT learners, the problem statement, the purpose statement, the research question and hypotheses, the theoretical framework, the operational definitions and key terms, the importance of the study, and the limitations and assumptions. Chapter two discusses the relevant literature on GT students and AP mathematics. The methodology for the study is described in chapter three including details on the population and sampling procedures, reliability of the instrument, human subject protections considerations, data collection methods, and procedures for data analysis. Chapter four summarizes participants' responses and includes analysis of the data, as well as summarizes the key findings. Chapter five provides a summary of the findings and conclusions related to prior studies. Recommendations for future studies are also discussed.

Chapter 2: Review of Literature

Introduction

This chapter describes the rationale, history, and a review of existing literature concerning gifted and talented students and the Advanced Placement program. This quantitative research study seeks to understand the perceptions of GT students compared to their non-identified GT peers in AP mathematics courses to determine if educational equity for GT students is occurring or not. The Response to Intervention model of using multiple levels of interventions to meet the needs of both struggling and advanced students is a popular method of intervention used in education to meet the needs of all learners, including GT, when used effectively. However, teachers must know the individual needs of each of GT students in their classrooms. For many educators, that may be difficult with the changing definitions of giftedness, the identification practices, and the policies of the state and federal governments. If schools and teachers find ways to differentiate the curriculum or allow for acceleration, more gifted students may find success in their educational journeys, while experiencing appeal in the learning, challenge in the curriculum, and choice in the experience.

Theoretical Framework

At the founding of the United States of America, the country's leaders did not deem education as a fundamental right in either the Declaration of Independence, the Constitution, or the Bill of Rights, but these documents did declare that all men were created equal. It was not until Amendment XIV was passed in Congress in 1866 that the right to education was addressed by declaring that all citizens of the United States were subject to the equal protection under the laws of each individual state. In 1867, the Department of Education was established to assist states in creating effective school systems and to collect data on schools (The Federal Role in

Education, 1997). It took the United States around ninety years to create a focus on education for all men, and the country is still looking for a way to reach equity in education for each individual person no matter their differences in gender, ethnicity, socio-economic status, or any other identifying characteristic, for there is “nothing so unequal as the equal treatment of unequals” (Bish, 1958, p. 16).

Educational equity means that each child’s learning results in learning something new each day and receiving instructional supports to perform at their highest personal level of capacity (Bish, 1958; Brookover & Lezotte, 1981; Colangelo et al., 2004; Davidson et al., 2004; Subotnik, Olszewski-Kubilius, & Worrell, 2011). Though, what is new for one child, may not be new for another, and likewise the level of capacity for each individual differs. Justice and equity in education for each child requires knowing what will stimulate each student’s mind and open the world of possibilities (Rockefeller Brothers Fund, 1961). Equity means that students have equal access, participation, and outcomes in their educational experiences (Brookover & Lezotte, 1981). In the world of special education, laws exist to ensure that disabled children receive an appropriate education with equal access and participation, and personalized learning outcomes (Colangelo et al., 2004; Subotnik et al., 2011). The Individuals’ with Disabilities Act (IDEA), a federal law, requires that all eligible students receive a free appropriate public education (FAPE) that provides at least some educational benefit (Kemerer & Sansom, 2013). *Brown v. Board of Education of Topeka* moved to desegregate schools and provide equal education benefits to all students no matter the color of their skin (Brookover & Lezotte 1981; Coleman, 1999; Imbeau, 1999; Russo, 2001; The Learning Network, 2012). For English Language Learners, the California Department of Education requires that there is a designated time during the school day to receive instruction to develop the language skills necessary for this population to be successful

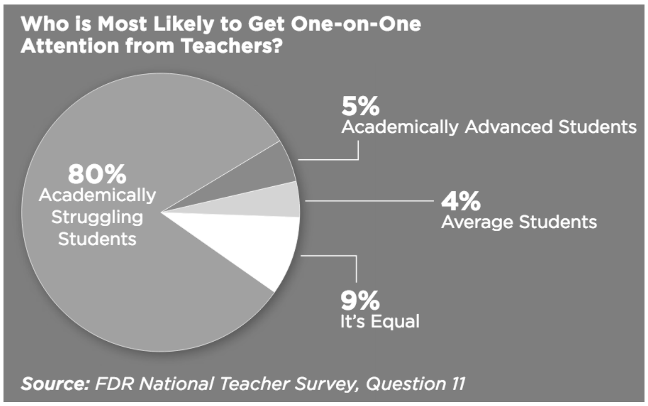
in their school program (Multilingual and English Learner Education Definitions, 1998). Although these mentioned programs do not always lead to the three standards of equity, they seek to provide regulations to enforce the standards of access, participation, and outcomes. Nevertheless, no protections exist for students who sit in classrooms on a daily basis unchallenged, uninspired, uninterested: gifted and talented students, and as some may argue many other students. Through all the mandates and changing school dynamics, "we cannot forget excellence in our effort to achieve equality" (Colangelo et al., 2004, p. 39), but must keep academic excellence at the forefront (Oakes, 1986).

The national ideology of the United States contends that all individuals are created equally, students included (Brighton et al., 2005; Davidson et al., 2004; Krist, 1999). Yet, to focus on the needs of all students, teachers must recognize the differences in students to seek justice and open children's eyes to the potential of their minds (Rockefeller Brothers Fund, 1961). America prides itself on democracy and its egalitarian educational system (Davidson et al., 2004; Heim, 1998; Russo, 2001; Siemer, 2009). Though through this ideal, the system of public schools is beginning to resemble factories which produce the same product consistently (Davidson et al., 2004). Schools are intent on "leveling out what [they] cannot level out – physical and intellectual inequalities" (Bish, 1958, p. 21), regardless of the fact that the differences in students may be from innate talents or physical or life circumstances. In terms of national pride and American superiority, citizens must be appalled to learn that the "factory" schools of the United States are struggling in the international educational world. The 2015 Trends in International Mathematics and Science Study (TIMMS) results show the United States ranking 103 points below the top-ranking Singapore on the eighth-grade international mathematics achievement test and 67 points below top-ranking Singapore on the eighth-grade

international science achievement test (Martin, Mullis, Foy, & Hooper, 2016; Mullis, Martin, Foy, & Hooper, 2016). For the United States to be successful in the twenty-first century and into the future, individuals graduating from U.S. schools, including GT, must also have the skills of creativity and innovation, which are not always fostered in "factory" schools (Kraeger, 2015). However, educational mandates in recent years have not focused on creativity, innovation or the identified GT as a targeted group. Instead, LCFF has grouped GATE funding with other categorical program funds in which school boards make decisions on whether or not to maintain their GATE program (GATE Funding Frequently Asked Questions, 2018).

No Child Left Behind (NCLB) changed the course of history for the GT population with a focus on closing the achievement gap for minority and disadvantaged students (Siemer, 2009). The focus of NCLB was on raising proficiency levels in reading and mathematics, and GT students in classrooms assist schools in strengthening test scores (Davidson et al., 2004; Siemer, 2009). With NCLB, funding disappeared for GT programs with California cutting 18%, or $10 million, of its budget for GT programs (Loveless et al., 2008). Currently, the federal government does not financially support GT programs, except for the Javits grant for research and does not mandate that states serve GT students. A 2008 survey conducted by the Farkas Duffett Research Group for the Thomas B. Fordham Institute showed that 80% of teachers are more likely to assist struggling students struggling academically, while only five percent are more likely to give individual attention to the GT students (Loveless et al., 2008; See Figure 2). On the same national survey, 86% of teachers reported that to achieve educational equity the United States must focus on all students learning, while only 11% answered that schools should focus on the struggling students (Loveless et al., 2008; See Figure 2). As shown in this data, the social attitudes of the United States about the egalitarian educational system causes educators and law

makers alike embarrassment in recognizing that not all students are created equal, and that students who are identified as GT need the same one-on-one attention as the other targeted demographic groups (Chval & Davis, 2009; Hollingworth, 1926).



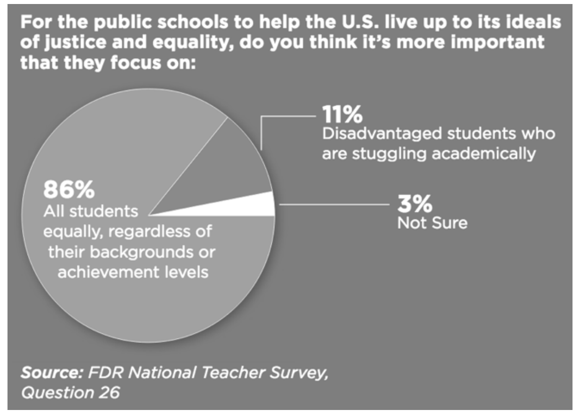


Figure 2. Results from a National Teacher Survey Conducted by the Farkas Duffett Research Group. From High-Achieving Students in the ERA of NCLB (p. 5), by T. Loveless, S. Farkas, and A. Duffett, 2008, Washington D.C.: Thomas B. Fordham Institute. Copyright 2008 by Thomas B. Fordham Institute. Reprinted with Permission.

The contributions of GT individuals shape the world each day by impacting the quality of life through inventions and economic stimulus (Heim, 1998). However, schools have focused primarily on how to identify different levels of talent through Intelligence Quotient tests and other standardized assessments, instead of focusing on how to develop the talents of these students who impact the world with their inventions, talents, and ideas (Rockefeller Brothers Fund, 1961). Schools have also focused on tracking students into courses based on perceived skill and ability levels (Oakes, 1986). It is known that gifted students do continue to progress in their schooling even without differentiation of their learning experience, but they do not move forward at a pace or depth that is at their level of need (Hollingworth, 1926). To excel, the GT need support in addressing real-world situations and problems in creative and supportive environments where their talents are fostered from kindergarten through twelfth grade (Frequently Asked Questions about Gifted Education, n.d.; Plucker & Callahan, 2014).

However, 58% of teachers report that they have not received training on working with the advanced students in recent years, and that GT students are not challenged in schools, and thus not thriving (Myths about Gifted Students, n.d.). All students deserve a quality education and should be challenged as much as possible. However, teachers are not prepared for those challenges, but instead focused on raising test scores.

Advanced Placement courses were created to challenge the unchallenged and accelerate the gifted, so the United States could contend with the Russian space exploration (Coleman, 1999; Cross, 1999; Haensly, 1999; Imbeau, 1999; Loveless et al., 2008; Mollison, 2006; Rehm, 2014; Rockefeller Brothers Fund, 1961; Siemer, 2009; Stewart, 1999; VanTassel-Baska, 2018). Yet, the AP program can be seen as an equalizer that promotes equal opportunities for all in pursuing the American Dream (Colangelo et al., 2004). Each teacher of an AP course is given the same framework to plan their lessons and each student is provided an opportunity to sit for the same end of course exam. Regardless of the type of school a student attends, ethnic background, or socio-economic status, the College Board has provided a level playing field for students to engage in college level material (Colangelo et al., 2004). The College Board has tried to increase the diversity of students engaging in their programs, but the college level courses remain a one-size-fits-all experience for many which may not lend itself towards the utilization of best teaching strategies (Hertberg-Davis et al., 2006).

For GT students to find success in classrooms (AP classrooms included), there is a need to emphasize depth and complexity within concepts, especially for students of mathematics who need intellectual challenges to find success (Poli, 2018). Some GT students require that the coursework be condensed so they have the opportunity to pursue their passions, research concepts in greater depth, and apply their learning to real-life concepts (Davidson et al., 2004,

Tredick, 2009). Many GT students need an expansion of learning around the basic skills of a discipline so as to observe how these skills will benefit society as they mature (Tannenbaum, 1983).

Response to Intervention. Solution Tree's Response to Intervention (RtI) model gained significant following when John Hattie (2012) ranked the effectiveness of RtI on student achievement as the third most influential support for student achievement, following self-reported grades/student expectations and Piagetian programs. Through the Professional Learning Community (PLC) and RtI programs, educators are asked to continually answer four questions:

1. What is it we want our students to learn?
2. How will we know if each student has learned it?
3. How will we respond when some students do not learn it?
4. How can we extend and enrich the learning for students who have demonstrated proficiency? (DuFour et al., 2006, p. 91)

To answer the first question, teachers decide in PLCs what is most essential to show mastery of a course to develop the essential skills. For the second question, the PLC works to create a common formative assessment (CFA) to prove student mastery. Within the RtI pyramid of interventions, teachers work to develop responses to assist struggling students and enrich the learning of advanced students to answer questions three and four. It is through these last two questions that teachers are tasked with providing educational equity to students and meeting their individual needs during interventions at each of the three tiers.

At the secondary level, RtI requires effective instruction based on "an evidenced-based, scientifically, researched core program" (Shapiro, n.d., para. 2) and a behavior plan such a

Positive Behavior Interventions and Supports (PBIS) (Johnson, Smith, Harris, & Mellard, 2009). Buffum, Mattos, and Weber (2010) showed that students do not all learn the same way, yet using researched practices around the nine categories of instructional strategies (Dean & Marzano, 2012) teachers can engage learners in the content and provide tools for application and self-motivation. The nine categories are:

1. Setting Objectives and Providing Feedback
2. Reinforcing Effort and Providing Recognition
3. Cooperative Learning
4. Cues, Questions, and Advance Organizers
5. Nonlinguistic Representations
6. Summarizing and Note Taking
7. Assigning Homework and Providing Practice
8. Identifying Similarities and Differences
9. Generating and Testing Hypothesis (Dean & Marzano, 2012, p. xviii).

These categories mirror the research of Hunter, Maheady, Jasper, Williamson, Murley, and Stratton (2015) in which maximization of student achievement occurs following five similar processes while making sure to monitor progress regularly and make adjustments as necessary. Through modifications and monitoring, differentiation practices can occur and "higher-order cognitive practices" (Kurz, Elliot, & Roach, 2015, p. 365) must be stressed to reach struggling and advanced students. Therefore, creating engaging and creative classroom environments through differentiation is the first priority of the RtI model.

RtI encourages differentiation to occur to meet the needs of all students, excelling or struggling. Using scaffolds, so students can process the content and create the desired product is,

"not optional at Tier I" (Buffum et al., 2010, p. 15) so as to meet the needs of all learners. Some students require small group instruction, modifications to assignments, or hints or samples to produce work to prove understanding of the content, close the gaps in learning, or offer extensions of the material. One option to create spaces for these scaffolds is learning centers and stations (Gregory, Kaufeldt, & Mattos, 2016). Centers are used heavily in elementary school classrooms to provide targeted instruction to small groups of blended students within the classroom, and could easily expand to be more commonly used at the secondary level. Using the results of formative assessments, an instructor can create stations and separate the students into groups needing specialized assistance or extension in a particular essential skill. Differentiation for GT students is crucial in allowing this population to grow to their fullest potential.

Historical Background

Differentiating the curriculum for GT individuals has been a focus for generations. However, defining who meets the criteria for exceptional excellence in academics and creative prospects has changed throughout the years through research and experience. Along with constantly shifting definitions, the state and federal policies regarding meeting the needs of GT students have altered based on the social and financial climate of the United States.

Defining gifted and talented. The early research on giftedness began by looking primarily at the individual and what characteristics identified those individuals as gifted (Plucker & Callahan, 2014). Around 1865, Sir Francis Galton gathered information on distinguished adults in high class British families who had made great achievements in the world concluding that genetics were the main factor leading to superior mental ability (Hollingworth, 1926; Tannenbaum, 1983). Alfred Binet and Theodore Simon's work and research led to the publication of the first intelligence test in 1905 and set the stage for future high stakes testing

(Cross, 1999; Jolly, 2004; Tannenbaum, 1983). Lewis Terman's work at Standford University refined Binet's intelligence scale after studying approximately fifteen hundred students with Intelligence Quotients (IQs) of 140 or above who were enrolled in California schools (Coleman, 1999; Fox, 1981; Imbeau, 1999; Jolly, 2004; Tannenbaum, 1983; Terman, 1925). Terman's findings suggested that a child's IQ can be used to predict the superior achievement of adults (Stewart, 1999; Tannenbaum, 1983; Terman, 1925). He was the first researcher to use the term gifted to label those in the top 1% of the intelligence scale (Stephens & Karnes, 2000). However, Terman did warn against the use of an intelligence test or scale as the only means to define intelligence (Renzulli, 2000). Leta Hollingworth's research in the 1930s and 1940s continued with the use of IQ tests to identify children as gifted, but with a focus on the creation of enriching curriculum for gifted students through classroom innovation and possible acceleration. There has been much criticism of the use of IQ tests in identification of GT and how these tests have created an underrepresentation of GT students due to the quantitative and verbal skills of some demographic groups, specifically Hispanic, African Americans, and Native Americans, not being as developed as others (Hodges et al., 2018; Kitano & DiJiosia, 2010; Sapon-Shevin, 1994). Although many of the previous researchers focused on aspects of giftedness through academics, Hollingworth (1926) also addressed special talents individuals may have in music, drawing, mechanical abilities. Guilford, like Hollingworth, challenged educators to adjust the definition of giftedness to include creativity shown through performance and abilities (Sayler, 1999).

The launch of Sputnik correlates with the change in the conception of giftedness to include those who may demonstrate high academic abilities. This conceptual change, the space exploration, and an infusion of money into the educational system correlated with the creation of

the Advanced Placement program (Sayler, 1999). The changing mindset on giftedness throughout the years was captured in the chart referenced by Tannenbaum (1983; see Figure 3).

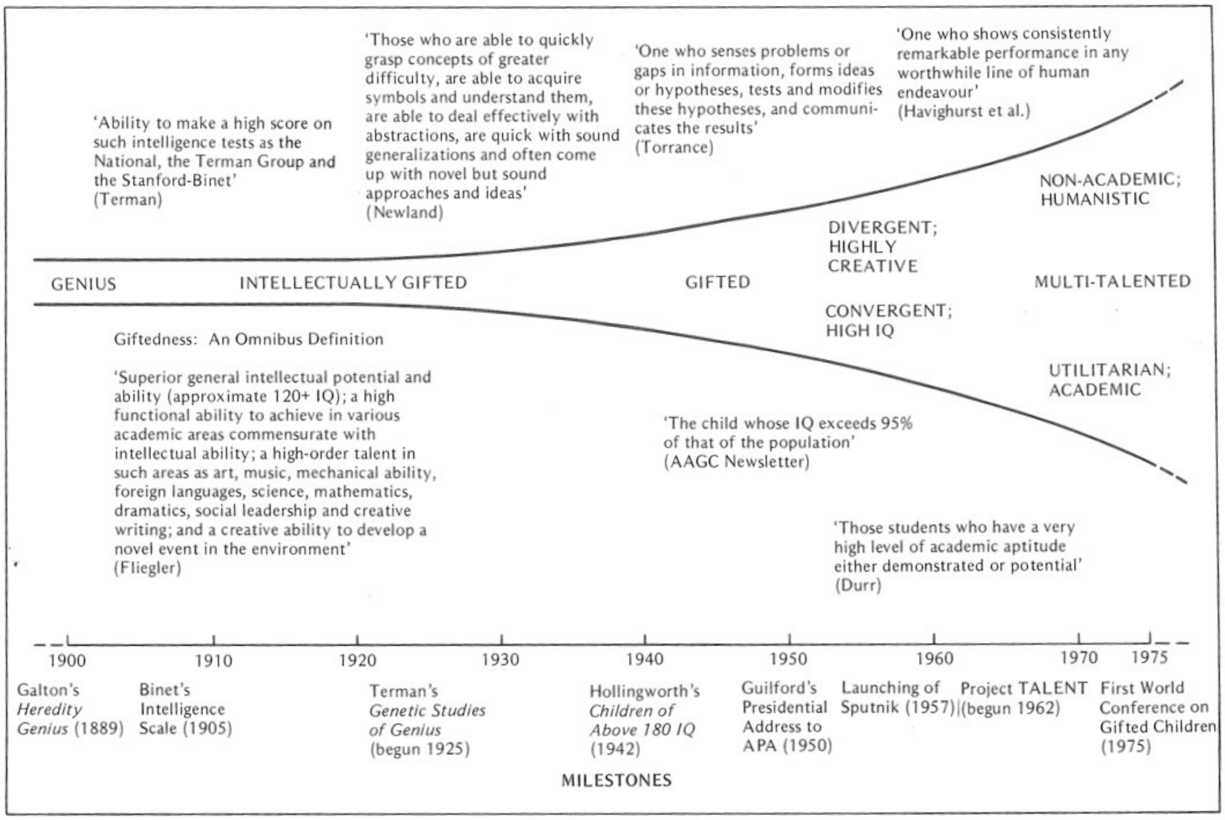


Figure 3. Changing conception of giftedness (Tannenbaum, 1983, p. 8). From Tannenbaum, *Gifted Children: Education, 1st, ©1983.* Reprinted by permission of Pearson Education, Inc., New York, New York.

Defining giftedness and talent took major turns in 1971 when the United States federal government defined giftedness (Haensly, 1999), in what is referred to as the Marland definition, in six domains:

1. General intellectual ability: success in schools subjects
2. Specific academic aptitude: strong skills in the scientific method, the use of numbers, and arithmetic reasoning

3. Creative or productive thinking: complex mental powers that allow a person to think flexibly, find uses for old items, develop ideas, and recognize problem
4. Leadership ability: the ability to improve relationships between people and help a group of people reach their goals
5. Visual and performing arts: talents in arenas needed by dancers, actors, writers, musicians, and artists
6. Psychomotor ability: success in craft skills that show prowess in spatial ability, visualizing patterns, and observing similarities, differences, and details (Tannenbaum, 1983).

The psychomotor ability domain was dropped in further legislation (Fox, 1981). The Marland definition is used by many states to write their own definitions of the characteristics of a GT student (Gallagher & Gallagher, 1994; Stephens & Karnes, 2000).

Following the Marland report, a shift occurred in perception of giftedness in which the characteristics of gifted students did not just include high achievement, but also the need to include motivational factors and productivity (Gallagher & Gallagher, 1994; Plucker & Callahan, 2014; Renzulli, 2011; Stephens & Karnes, 2000; Tannenbaum, 1983). Renzulli's (2011) three-ring model of giftedness stated that a gifted student possessed an interaction, similar to the overlapping of a Venn Diagram (see Figure 2-2), in their task commitment, creativity, and above average ability (Brown, Renzulli, Gubbins, Siegle, Zhang, & Chen, 2005). Renzulli's above-average ability criteria references the potential for a person to perform well in academic subjects, as well as in artistic pursuits (Renzulli, 2011; Renzulli, 2000). An individual with a renowned task commitment has self-confidence, is dedicated to their practice, perseveres, works hard, and consistently models a fascination for a particular subject (Haensly, 1999; Renzulli, 2000). The

third cluster in Renzulli's work suggests that gifted students must also be creative in their approaches and thinking to solve problems (Renzulli, 2000; Stewart, 1999; Tannenbaum, 1983).

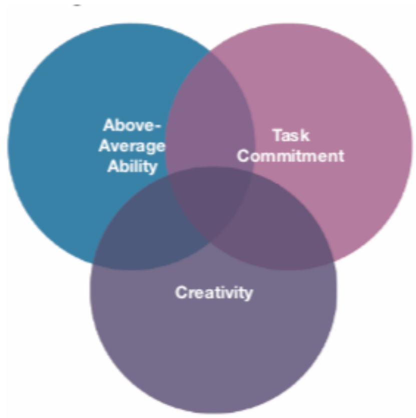


Figure 4. Renzulli's Three-Ring Concept of Giftedness. From "What makes giftedness? Reexamining a definition," by J. Renzulli, 2011, *Phi Delta Kappan,* 92*(8*), p. 83. Reprinted with permission.

Gardner (2011) wrote of his theory of multiple intelligences (MI theory) in 1983 adding to the literature on looking beyond IQ scores to identify the gifted (Armstrong, 2018). His eight intelligences looked to expand on the focus from just language arts and mathematics to include the intelligences of linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, and naturalist (Armstrong, 2008; Multiple Intelligences, n.d.). Sternberg (2003) developed his triarchic theory of successful intelligence which included three components: (a) the ability to be successful in one's own world, (b) the ability to use one's strengths to find success and offset for personal weaknesses, and (c) the ability to adapt to all different environments encountered (Gallagher & Gallagher, 1994). Sternberg (2003) addressed the success of an individual, or the giftedness, as the level in which a person was able to balance the creative, analytical, and practical abilities of real-world situations.

Gagnè's Differentiated Model of Giftedness and Talent (DMGT; 1999) separated the terms of GT with giftedness being the untrained and innate ability that makes a person perform in the top 10% of his peers (Plucker & Callahan, 2014). Talents develop from systematically

developing one's gifts through learning and practicing, while balancing the environmental factors and intrapersonal catalysts (See Figure 2-3; Gagnè's Differentiated Model of Giftedness and Talent ([DMGT]; 1999). Gagnè's model addressed the potential for gifts to not develop and for those identified as GT to not achieve at high levels based on motivation, physical abilities, or events occurring during the developmental process of these talents (Plucker & Callahan, 2014). Likewise, Subotnik, Olszewski-Kubilius, Worrell (2011) define giftedness in the beginning stages as being about the potential to perform, and in the later stages, giftedness is the eminence of the fully developed gifts. Thus, to be gifted in a specific talent, there is a balance of ability, motivation, creativity, as well as a need for passion, interest, commitment, and opportunity (Subotnik et al., 2011).

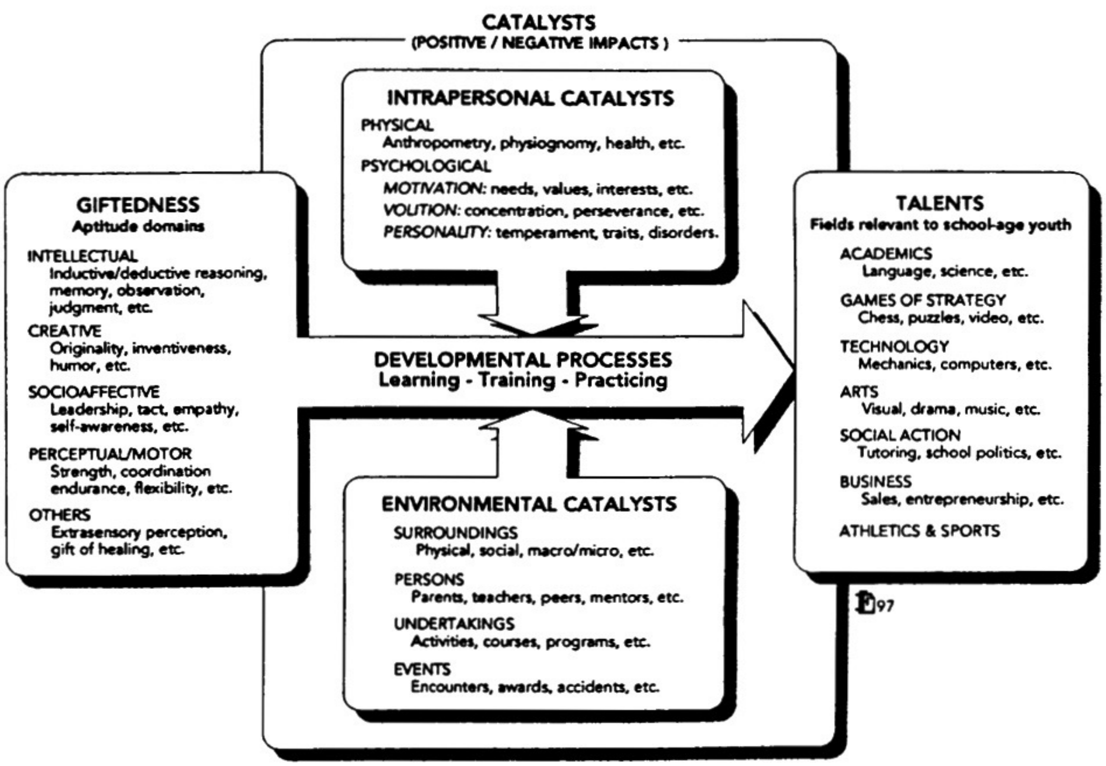


Figure 5. Gagnè's Differentiated Model of Giftedness and Talent (DMGT) From "*Gagnè's Differentiated Model of Giftedness and Talent (DMGT)*" by F. Gagnè, 1999, *Journal for the Education of the Gifted, 22, 2*, p. 231. Copyright 1999. Reprinted with permission.

In 2002, the No Child Left Behind Act modified the federal definition of GT students seemingly based on the body of literature reviewed above including many faucets of the individual and balancing academic and creative gifts and talents. The current federal definition states

> The term gifted and talented, when used with respect to students, children, or youth, means students, children, or youth who give evidence of high achievement capability in areas such as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who need services and activities not ordinarily provided by the school in order to fully develop those capabilities (No Child Left Behind [NCLB], 2002, Sec. 9101 (22)).

Although this is the federal definition of GT, each state department of education has the ability to write their own definition. The state of California defined a GT pupil as a student "who is identified as possessing demonstrated or potential abilities that give evidence of high-performance capability" (California Department of Education, 2005, p. 9). California further defines a highly gifted student as one with an IQ above 150 and showing great achievement in mathematics, science, or language arts. In addition, students are identified as having high performance capability in creative, leadership, performing arts, or visual arts.

Gifted policies in education. The first foray into the policy regarding GT individuals was Thomas Jefferson's *A Bill for the More General Diffusion of Knowledge* that was not passed by the House of Delegates in both 1778 and 1780 (A Bill for the More General Diffusion of Knowledge, n.d.; Cohoon, 2015). Although Thomas Jefferson's bill did not pass through Congress, James Madison was able to have the Act to Establish Public Schools pass through Congress in 1796 to begin Jefferson's idea that engaging in democracy required citizens to be educated (Brackemyre, 2015). The public education system was intended for citizens, not necessarily GT citizens alone. Yet, even with the passing of the Act to Establish Public Schools, schooling was still primarily done in private religious institutions. Throughout the nineteenth

century, the public education system grew with the classrooms, in both public and private schools, containing multiple age groups of students, allowing for each child to progress as quickly or as slowly as needed, the original differentiation and acceleration mentalities (Neem, 2016; Sayler, 1999). Many states were establishing their own school systems to educate children (Neem, 2016).

Horace Mann introduced the idea of "Common Schools" in 1848, separating students into grades and having progression between the grades (Brackemyre, 2015). Schools that were arranged by age were still accelerating students who were GT through the concept of a flexible graduations or promotions based on completion of the curriculum from the first eight years of school (Tannenbaum, 1983). William Torrey Harris, the superintendent of public school is Missouri, established a program for gifted students allowing them to advance quickly, every five weeks, based on curriculum performance, while cities such as Cincinnati and Los Angeles provided opportunity classes for the GT students (Cohoon, 2015; Jolly, 2004).

Following World War I, the Progressive Education Movement of the 1920s saw a shift towards the understanding that students had individual needs that needed to be matched to a specific program, such as magnet schools which grouped similar ability students together (Hollingworth, 1926; Sayler, 1999; Tannenbaum, 1983). The goal of these programs was for students to go deeper within the curriculum and enrich the minds of the GT (Tannenbaum, 1983). Another ability grouping method used during this time was the X-Y-Z plan, which divided a grade level into three groups based on performance, with one group of students being the slower learners and another being formed from the brightest population (Jolly, 2004; Sayler, 1999).

The Great Depression saw a withdrawal of funding and special programs for GT students, among many other financial woes (Sayler, 1999; Tannenbaum, 1983). However, in the midst of

the Great Depression in 1931, the United States Department of Education established the Section on Exceptional Children and Youth (Cohoon, 2015; Russo, 2001; Siemer, 2009). With the recognition that the economic upheaval was adjusting practices in schools, the United States Department of the Interior and the Office of Education issued a briefing on *The Education of Exceptional Children* (Foster, Iedell, Smith, Martens, McLeod, & United States Department of the Interior, 1933) calling for American to educate each child to meet their personal needs. This call for action did not cause widespread special opportunities for the gifted (Tannenbaum, 1983).

During World War II, and following, saw a shift in GT education through policies and classroom practices. Classrooms saw a shift in teacher education curriculum towards a how-to model versus a depth of understanding and rigorous curriculum model (Sayler, 1999). Schools were allowing students to show competency of content through the use comprehensive examinations, instead of attendance at school, and many schools were offering accelerated programs (Sayler, 1999). In 1950, Congress pass the first federal legislation to address the needs of GT students with the National Science Foundation Act, which provided scholarships and research to stimulate the sciences and mathematics (Cohoon, 2015; Russo, 2001; Siemer, 2009). Closely following in 1954, the National Association of Gifted Children was founded with the mission to advocate for the GT through educational practices and research (Cohoon, 2015).

The Soviet Union launched their first artificial satellite, Sputnik I, into orbit on October 4, 1957. The United States had been working since 1955 to create and launch its own satellite, and was beaten in the space race by the Russians (Garber, 2007). The United States started pouring money into education with a focus on sciences, mathematics, foreign language, technology, and gifted students (Coleman, 1999; Cross, 1999; Fox, 1981; Haensly, 1999; Imbeau, 1999; Loveless et al., 2008; Mollison, 2006; Rehm, 2014; Rockefeller Brothers Fund,

1961; Russo, 2001; Siemer, 2009; Sayler, 1999; Stewart, 1999; Subotnik et al., 2011; VanTassel-Baska, 2018). The country feared that their defenses were down, and passed the National Defense Education Act of 1958, which called for schools to strengthen their identification of gifted children (Tannenbaum, 1983). Students were also able to take advanced courses, enter college early, and learn from specialists in the field (Sayler, 1999; Tannenbaum, 1983; VanTassel-Baska, 2018). Out of this fear of being behind and defenseless, the Ford Foundation's 1953 Advanced Placement program gained popularity.

An early leader in gifted education, California in 1961, created the Mentally Gifted Minor program to support the learning for students who scored in the 98th percentile or above on intellectual ability tests (Laws & Regulations, 2018; VanTassel-Baska, 2018). However, the 1960s was a decade focused on ending inequities due to race and financial status, so identification of GT was encouraged, but ability-grouping and acceleration was discouraged (Cohoon, 2015; Sayler, 1999; Tannenbaum, 1983). The US Congress added "Provisions Related to Gifted and Talented Children" to the Elementary and Secondary Educational Amendments in 1970, which mandated that GT students receive services under Titles II and V (Russo, 2001; Tannenbaum, 1983). The legislation led to the US Commissioner of Education, Sidney Marland, report in 1972. From this report, came what is dubbed the *Marland definition* of giftedness and a call for differentiation from the traditional school programs for GT students to be able to fully contribute to society and reach their full potential (Baker, 2001; Cohoon; Gallagher & Gallagher, 1994). The Marland report renewed an interest in the gifted population of students and their curriculum, teacher education, and leadership training. In 1974 as part of the Amendments to the Elementary and Secondary Education Act, the Federal Office of Gifted Education was formed and additional federal funds were made available for programs for GT programs (Russo, 2001;

Sayler, 1999). However, the additional eighty million dollars in funds made available only allotted to about one dollar per student (Russo, 2001).

Focus shifted to students with disabilities in 1973 with the passage of Individuals with Disabilities Education Act (IDEA) (Russo, 2001; Tannenbaum, 1983). The IDEA provides federal funding to states to educate students with disabilities (Kemerer & Sansom, 2013). In the Pennsylvania courts in 1986, a student challenged her exclusion from gifted education services under IDEA holding that she was considered handicapped by her giftedness (Heim, 1998). In *Roe v. Pennsylvania,* the student lost her case and the court concluded that students who are gifted are not considered handicapped and thus received no protections under IDEA. Similar cases have been tried in other states resulting in a similar outcome affirming that gifted students are not considered special education students (Russo, 2001). However, these rulings strengthen the argument for the RtI approach of three tiers of interventions to successfully reach all students, including the use of enrichment activities for GT learners.

In California in 1980, the state Assembly established the Gifted and Talented Education (GATE) program. The program gave school districts the power to establish their own criteria for identification of the GT and structure services to meet the needs of the GT (Laws & Regulations, 2018). The *A Nation at Risk* publications in 1981 and 1983 pushed for equity in the Advanced Placement courses by encouraging the courses to be offered in more schools with varying demographic groups and a move above from mediocrity (Rehm, 2014; Russo; 2001; Rothschild, 1999; Sayler, 1999). Javits Act in 1988 established the Federal Office of Gifted and Talented and the National Research Center on the Gifted and Talented (Baker, 2001; Hargrove, 1999; Imbeau, 1999). The Javits Act focused on research initiatives to assist in identification of the gifted and how to foster the talents and gifts of all students, no matter their background, for example their

economic status, ability to speak English, their race, or possible disability (Imbeau, 1999; Russo, 2001).

The 1990s brought a renewed focus in research on best practices for the gifted including identification, curriculum, and programs with the creation of National Research Center on the Gifted and Talented, a consortium of researchers from different universities (Sayler, 1999). As of 2018, there are twenty research centers at universities throughout the United States (VanTassel-Baska, 2018). With a developing focus on research, the 1993 report National Excellence: A Case for Developing America's Talent detailed how America is failing its most elite students in what the US Secretary of Education, Richard Riley, called a "quiet crisis" (Ross & Office of Educational Research and Improvement, 1994). Students were not being challenged and the US was not competing strongly in the global community (Ross & Office of Educational Research and Improvement, 1994; Sayler, 1999).

At the dawn of the twenty-first century, California amended its GATE educational codes to require that students receive differentiated learning during the school day and to allow GT students to attend college no matter their age (Laws & Regulations, 2018). However, No Child Left Behind switched the focus from differentiation for GT students through not listing GT students as a tracked demographic group in the disaggregation of reported student achievement data, and instead the focus turned towards the instruction of teaching to the low or middle performing group of students (Hodges et al., 2018; Loveless et al., 2008; Siemer, 2009). This change in focus has led to a loss in funding, research, professional development, and curriculum development for the GT (Siemer, 2009; VanTassel-Baska, 2018).

This change in focus towards improving the performance of low achieving students continues in education. California has made provisions for schools to develop funding formulas

through the Local Control Funding Formula (LCFF) to provide monies to develop programs for GT students (Laws & Regulations, 2018). However, in the LCFF legislation the GATE program was repealed eliminating GATE as a categorical fund. The US federal government passed the Tested Ability to Leverage Exceptional National Talent (TALENT) Act in 2017 which amended the Elementary and Secondary Education Act. TALENT did not create programs, but added GT students into the Elementary and Secondary Education Act by requiring training of educators who receive grant funding, having states report out how they are working to close achievement gaps especially in schools designated as Title I, and provide evidence of instruction for GT learners (TALENT Act, n.d.).

Throughout the years, there have been many federal guidelines and reports on giftedness, but education is left primarily to the states. Therefore, there is no federal mandate for states to meet the needs of their GT population (Siemer, 2009; VanTassel-Baska, 2018). There is not a common definition of GT, nor is there guaranteed funding, or effective programming for GT individuals (Siemer, 2009). In 2001, state spending for GT students was two cents out of every one hundred dollars in education, while in 2017 the federal government funded the Javits research program with twelve million dollars for over 3.2 million students (Frequently Asked Questions about Gifted Education, n.d.; Russo, 2001). Gifted education remains one of the few areas in which local school districts have control, thus differences in identification, programing, and education differ from school district to school district, and in some locations based on the financial capacity of the school district (Baker, 2001).

Mathematical giftedness. Russian researcher Krutsetskii argued that the mathematically gifted fall into three types of talent: analytical thinkers, geometric thinkers, and harmonic thinkers (Gibson, 2017; Usiskin, 1999). Analytical thinkers succeed in algebra and arithmetic

conquests, while geometric thinkers thrive with visual and spatial problems. Harmonic thinkers are a blend of the analytical and geometric thinkers, but some prefer to do mental math and others prefer the visual models. The National Council of Teachers of Mathematics' (NCTM) 1999 Task Force on Mathematically Promising Students preferred using the term promising to define students who possibly may be gifted in mathematics depending on their experiences, beliefs, ability, and finally motivation (House, 1999; Wertheimer, 1999). In this sense, NCTM's Task Force believed that giftedness in mathematics was not predetermined, but could be developed through providing opportunities for students to engage in mathematics learning (Wertheimer, 1999).

Identification of gifted and talented students. Educational policies for the GT population have been inconsistent or not enforced for GT learners in the same way the policies and enforcement have been for special education students through the Individualized Education Plans (IEPs). Likewise, the defining of characteristics and qualities of GT individuals has not reached complete consensus across the country, across the world, or in the literature, as referenced earlier. Without the policies and definitions being standardized, it is not surprising that educators have had trouble identifying who is GT or that different states and school districts have different methods of identification (Richert, Alvino, & McDonnel, 1982; Stephens & Karnes, 2000). With this inconsistency, the vital step of determining the appropriate educational needs and program is lost because the GT student's specific talents are not fully captured (Hodges et al., 2018; Richert & Kansas State Board of Education, 1992).

Due to the early education research completed by Binet, Simon, and Terman (1925) and the research's longevity, the IQ test has great popularity in the identification of GT individuals (Brown et al., 2005; Cross, 1999; Jolly, 2004; Subotnik et al., 2011; Tannenbaum, 1983). Yet,

intelligence tests do not include the creative and talent descriptors included in more recent definitions of giftedness nor do they always accurately predict the success on creative thinking tasks, such as problem solving, or the future accomplishments of adults (Arbolino, 1961; Brown et al., 2005; Hodges et al.; Richert & Kansas State Board of Education, 1992; Russo, 2004). IQ tests have come under criticism for their validity and in being the sole tool used to identify high-ability.

The Civil Rights movement of the 1950's brought many arguments against the use of IQ tests in selection for programs for the gifted (Tannenbaum, 1983). Schools were encouraged to rethink how to include children of color in gifted programs in order to maximize the talent of the nation (Cross, 1999; Imbeau, 1999). There was a call for rethinking access and equalizing of opportunities available (Coleman, 1999). Not only have IQ tests come under criticism due to race injustice, but economically disadvantaged students do not tend to score high on standardized achievement tests or IQ tests, even when financial constraints are controlled (Hodges, 2018; Siemer, 2009; Wertheimer, 1999).

Through the changing definitions of giftedness over the years and the political and financial climates of United States, the federal government has only required that school districts identify GT students using experts in the field (Fox, 1981). Identification of high-ability students is difficult and is made more difficult when using a comprehensive method of identification (Arbolino, 1961; Brown et al., 2005). Methods of identification may include evaluations of performances, review of student work samples, achievement tests, teacher feedback, parent responses, auditions, rating scales, self-reports from the student, and non-verbal tests (Brown et al., 2005; Fox, 1981; Hodges et al., 2018; Richert & Kansas State Board of Education, 1992; Tannenbaum, 1983; Wertheimer, 1999).

However, due to the easy nature of using achievement tests, many school districts put the most promise into the academic assessments which may account for the disproportionate rates of high income, white and Asian students identified as GT, and possibly an overrepresentation of GT students overall (Hodges et al., 2018, Kitano & DiJiosia, 2001). At the school district level, identification of GT students includes nomination, screening, and selection (Johnson, 2009). School districts in California normally assess students between second and fifth grade using a universal screening process with the Otis Lennon School Ability Test (OLSAT), Naglieri Nonverbal Ability Test (NNAT3), Cognitive Abilities Test Screener (CogAT), and the results from the Smarter Balanced Assessments ("Curriculum: GATE identification," 2018-2019; "GATE Testing and Identification," n.d.; "Gifted and Talented Education," n.d.; "Gifted and Talented Education (GATE)," n.d., "Identification, Support, & FAQ," n.d.). Some districts also report using a search and referral process, followed by screening, and then committee review of academic abilities, intellectual assessment, audition, or demonstration of talent ("GATE Identification Process," n.d.). Although, these methods are the ones generally used in California districts, there are many screening tools in existence that measure based on the type of talent, the population type the test is designed for, and age level for admiration (See Table 1).

Table 1

Measures Used in Screen the Gifted (Tannenbaum, 1983, p. 368-370). From Tannenbaum, *Gifted Children: Education, 1st, ©1983.* Reprinted by permission of Pearson Education, Inc., New York, New York.

	Talent Category					Population		Age			
Instrument	General Intellectual	Specific Academic	Creativity	Leadership	Visual and Performing Arts	Advantaged	Disadvantaged	Early Childhood	Grades 4-8	High School to Adult	K-12
A.S.S.E.T.S.	+	+	+		+	+		+	+		
Barron-Welsh Art Scale					+	+		+	+	+	+
Biographical Inventory-Form U (IBRIC)		+	+	+	+	+			+	+	
California Achievement Tests		+				+					+
Cartoon Conversation Scales	+						+	+	+		
Cattell Culture Fair Intelligence Series	+						+	+	+		
CIRCUS	+	+				+	+	+			
Cognitive Abilities Test	+					+		+	+	+	
Columbia Mental Maturity Scale	+					+	+	+	+		
Comprehensive Tests of Basic Skills		+				+					+
Creativity Assessment Packet			+			+		+	+	+	
Creativity Tests for Children			+			+			+	+	
Design Judgement Test					+	+			+	+	
Differential Aptitude Tests	+	+				+			+	+	
Feuerstein Learning Potential Assessment Device	+						+		+	+	
Gifted and Talented Screening Form	+	+	+	+	+	+		+	+	+	
Goodenough-Harris Drawing Test	+					+	+	+	+	+	
Group Inventory for Finding Creative Talent (G.I.F.T.)			+			+		+	+		
Group Inventory for Finding interests (G.I.F.F.I.)			+			+				+	
Guilford-Holley Leadership Inventory						+				+	
Guilford-Zimmerman Aptitude Survey		+				+				+	
Hemmon-Nelson Tests of Mental Ability	+					+					+
Horn Art Aptitude Inventory					+	+	+			+	
Iowa Tests of Basic Skills		+				+		+	+	+	
Kranz Talent Identification Instrument		+		+	+		+				+
Khatena-Torrance Creative Perception Inventory			+			+			+	+	

(continued)

Instrument	Talent Category					Population		Age			
	General Intellectual	Specific Academic	Creativity	Leadership	Visual and Performing Arts	Advantaged	Disadvantaged	Early Childhood	Grades 4-8	High School to Adult	K-12
Lorge-Thorndike Intelligence Tests	+					+					+
Meier Art Judgement Tests					+	+			+	+	
Metropolitan Achievement Tests		+				+		+	+		
Musical Aptitude Profile					+	+	+		+	+	+
Otis-Lennon Mental Ability	+					+		+	+		+
Peabody Individual Achievement Test		+				+					+
Pennsylvania Assessment of Creative Tendency			+			+			+	+	
Piers-Harris Children's Self-Concept Scale						+	+		+	+	
Preschool Talent Checklists	+	+	+	+	+	+	+	+			
Primary Measure of Music Audiation					+	+	+	+			
Raven Progressive Matrices-Advanced	+					+	+			+	
Raven Progressive Matrices-Standard	+					+	+	+	+		
Mednick Remote Associates Test			+			+			+		
Ross Test of Higher Cognitive Processes	+					+			+		
Scales for Rating Behavioral Characteristics of Superior Students	+		+	+	+	+					+
Seashore Measure of Musical Talents					+	+	+		+	+	
The Self-concept and Motivation Inventory (SCAMIN)						+	+	+	+	+	
Sequential tests of Educational Progress (STEP)		+				+			+	+	
Short Form Test of Academic Aptitude	+	+				+		+	+	+	
Slosson Intelligence Test	+					+		+	+	+	
SOI Gifted Screening Form		+	+			+	+	+	+	+	
SOI Learning Abilities Test		+	+			+	+	+	+	+	
SRA Achievement Series		+				+					+
Stallings Environmentally Based Screen	+						+	+			
Stanford Achievement Test		+				+		+	+	+	
Stanford-Binet Intelligence Scale	+					+		+	+	+	
System of Multicultural Pluralistic Assessment (SOMPA)	+						+	+			
Tennessee Self-concept Scale						+			+		

(continued)

Instrument	Talent Category					Population		Age			
	General Intellectual	Specific Academic	Creativity	Leadership	Visual and Performing Arts	Advantaged	Disadvantaged	Early Childhood	Grades 4-8	High School to Adult	K-12
Test of Creative Potential			+			+		+	+		
Tests of Achievement and Proficiency		+				+					
Thinking Creatively with Sounds and Words			+			+		+	+	+	
Torrance Tests of Creative Thinking			+			+	+				+
Vane Kindergarten Test	+	+				+					
Watson-Glaser Critical Thinking Appraisal	+					+			+	+	
Wechsler Intelligence Scale for Children Revised (WISC-R)	+					+		+	+	+	
Weschler Preschool and Primary Scale (WPPI)	+					+		+			
Cumulative grades	+	+	+	+	+	+	+	+	+	+	+
Informal observation	+	+	+	+	+	+	+	+	+	+	+
Parent essay – why child needs program	+	+	+	+	+	+	+	+	+	+	+
Peer nomination	+	+	+	+	+	+	+	+	+	+	+
Products	+	+	+	+	+	+	+	+	+	+	+
Self-nomination	+	+	+	+	+	+	+	+	+	+	+
Student interview	+	+	+	+	+	+	+	+	+	+	+
Teacher nomination	+	+	+	+	+	+	+	+	+	+	+

Identification of gifted mathematicians. To identify a student's promising mathematics ability, or their giftedness in mathematics, an educator should observe how a child observes quantitative and spatial relationships (House, 1999). Russian mathematician, Krutetskii, believed that mathematical giftedness presents itself around the age of seven or eight (Gallagher & Gallagher, 1964; Tannenbaum, 1983; Usiskin, 1999). Characteristics of the mathematically gifted include

> General intelligence and/or verbal skill; spatial visualization; confidence in learning mathematics; perceived attitude of mother, father, and teacher toward one as a learner of mathematics; perceived usefulness of mathematics; effective motivation in mathematics (a kind of joy in problem solving); and for girls only, the extent to which mathematics is perceived as a sex-neutral rather than a male domain. (Tannenbaum, 1983, p.139)

In identifying mathematically promising students, educators must not just look at computation-based assessments, but also observe if students can flexibly handle data, transfer ideas, generalize, organize data, and have originality in their interpretations of problems and ideas (Gallagher & Gallagher, 1964). Ultimate success for GT learners in mathematics requires nurturing and guidance of their mathematics interests and talents so that students reach their ultimate potential (Usiskin, 1999).

The Advanced Placement program. The Ford Foundation funded two studies whose results led to the formation of the Advanced Placement (AP) program in 1953 (Clark, Moore, & Slate, 2012; Nguent & Karnes, 2002; Raskin, 2017; Rothschild, 1999). The original goal of the program was to assist students in entering college with higher standing and reduce the duplication of material taught in the last two years of secondary education and the beginning year of college (Arbolino, 1961, 1964; Colangelo et al., 2004; Freedman & Frugman, 2001; Hertberg-Davis, Callahan, & Kyburg, 2006; Rehm, 2014; Rothschild, 1999). Pilot exams were administered by the Educational Testing Services, a subsidiary of the College Entrance Examination Board, in 1954, to students at seven schools with the full kick off of the program in 1955 (Mollison, 2006; Rehm, 2014). The College Board took ownership of the program in 1955 and in 1956, 1,299 students from 104 schools took the exams offered in eleven subject areas, including mathematics (Mollison, 2006; Nugent & Karnes, 2002; Rehm, 2014). The launch of Sputnik saw a rapid growth in the program with an increase of 711% in the number of students participating in the program from 1956 to 1960 (See Table 2; Coleman, 1999; College Board, 2018a; Cross, 1999; Haensly, 1999; Imbeau, 1999; Loveless et al., 2008; Mollison, 2006; Rehm, 2014; Rockefeller Brothers Fund, 1961; Siemer, 2009; Stewart, 1999; VanTassel, 2018).

Table 2

Participation in the AP Program (College Board, 2018a)

	1956	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**	**2018**
Number of Students	1,299	10,531	55,442	119,918	330,080	768,586	1,845,006	2,808,990
Number of Examinations	2,199	14,158	71,495	160,214	490,299	1,272,317	3,213,225	5,090,324
Number of Schools	104	890	3,186	4,950	9,292	13,253	17,861	22,612

Since the creation of the AP program, great growth has been seen in the number of students and schools participating in its courses and examinations (See Table 2). In 2018, across the United States, 308,538 students took the Calculus AB exam, 139,376 the Calculus BC exam, and 222,501 the Statistics exam. In California alone, 7,94,126 Advanced Placement mathematics exams were taken with 119,080 of those graded exams receiving a score of 5, and mean scores of 2.99 on the Calculus AB exam, 3.82 on the Calculus BC exam, and 2.84 on the Statistics exam (See Table 3; College Board, 2018b). Not only has there been growth in the number of participants, but there has been a push for equity and access to the AP program with the number of students from low-income backgrounds taking the AP test increasing by 217,375 students from 2003 to 2013 (College Board, 2014). There has also been a push for more participation in the AP program by minority students with the College Board seeing a 628% increase in the number of African-American students taking exams from 1997 to 2004 (Hertberg-Davis et al., 2006).

Table 3

California Participation in the AP Program with a focus on mathematics courses (College Board, 2018b)

		Number of students for each examination					
	AP Score	Total Exams	Calculus AB	Calculus BC	Statistics	Number of Students at each grade level	
California Total	5	119,080	11,180	10,131	5,191	< 9th	761
	4	158,314	8,580	4,176	6,782	9th/10th	105,759
	3	191,465	9,877	4,348	7,707	11th	160,669
	2	181,485	10,468	3,075	4,881	12th	146,209
	1	143,782	10,545	1,279	8,851	Not HS	7,743
Total		794,126	50,650	23,009	33,392	Total	421,141
Mean Score		2.91	2.99	3.82	2.84		

The talent mobilization which occurred after the launch of Sputnik led to homogenous groupings of gifted students and the acceleration of GT students to counteract the forward movement of the Russians (Siemer, 2009). The AP program was believed to have been the answer to meeting the needs of the GT in secondary schools with its faster pace, motivated peers, and talented teachers (Arbolino, 1964; Raskin 2017). However, Arbolino (1964) also believed that the AP curriculum constricts experimentation, limits the growth of curriculum, and that teachers are not willing to alter their teaching methods with old courses to meet the AP frameworks. Raskin (2017) argues that the program is fact-based, lacking the depth of content needed for GT students. The twenty-first century skills of critical thinking, communicating, and creativity are not intertwined in the curriculum as needed because of the fast-paced structure (Raskin, 2017; Trilling & Fadel, 2009).

Through the growth of the AP program and the push for equity and access, the initial homogenous groupings have transformed to heterogenous groupings with students of all backgrounds and caliber (Mollison, 2006; Rehm, 2014). Although the groups of students were not all identified as gifted, Hertberg-Davis, Callahan, and Kyburg (2006) found that AP students were treated as a homogenous group. Teachers did not tend to alter materials or lesson plans to meet the needs of advanced learners or struggling learners or any diverse learner in their classroom due to goal of covering all course material before the AP exams (Raskin, 2017). Even if the group of students is all identified as gifted, teachers must remember that each gifted student has different needs and material must be differentiated to meet their needs (VanTassel-Baska, 2000). Students in the Hertberg-Davis et al. (2006) study recognized the challenge offered in the AP course as the highest offered in their school, but the course appealed to them most for its boost in applying for college entrance.

Though the AP program was designed initially for an elite group of students who wanted an academic challenge, the College Board believes that even with the growth of the program they are still able to prepare students for college and its rigor (College Board, 2001). According to GT students, the AP program is the most advantageous program they interact with during high school (VanTassel-Baska, 2000). Students are provided the opportunity for acceleration, higher-order thinking skills, emphasis on advanced concepts, and the expectations are at a high level (Clark, Moore, & Slate, 2012; VanTassel-Baska, 2000). Gifted students have the ability through the AP program to take these advanced courses starting their freshman year, or engage over the summer through institutes for the gifted, or throughout the school year through independent study programs online (VanTassel-Baska, 2000).

Advanced Placement mathematics courses. Each AP math course is provided with a framework covering the topics to be taught and sample questions (Hertberg-Davis et al., 2006). Each course, Calculus AB, Calculus BC, and Statistics, is designed with collaboration between high school teachers and college professors (Hertberg-Davis et al., 2006). The College Board hosts workshops and summer institutes to provide intensive training that reviews course outlines and curriculum, offers instructional practice ideas, provides examples of scoring guidelines, and student work samples (About AP Summer Institutes, n.d.; Hertberg-Davis et al., 2006). Teachers are required to submit a syllabus to the College Board via the course audit to ensure that the curriculum and resource requirements meet the AP designation status (College Board, 2010; College Board, 2016). Students are assessed on their understanding via an exam created by the Educational Testing Service that poses questions in both multiple choice and free response, or written, formats. The exams are scored by experts in the field and given scores of 5, 4, 3, 2, 1, with a 5 representing an A in a college course and acknowledgement of students being extremely well qualified, while a 4 represents an A-, B+, or B in the college level course meaning a student is well qualified, and a 3 represents a B-, C+, or C and the designation of qualified (College Board, 2010; Krist, 1999). Therefore, typically a student is seen as getting a passing score when they receive a three or higher on the examination. However, colleges have the choice to award credit towards degree completion or not (Hertberg-Davis et al., 2006).

The two Advanced Placement Calculus courses cover similar concepts of Limits, Derivatives, and Integration. Calculus BC also covers Series. The Calculus AB and BC courses are comparable to the first semester of college calculus, and the BC course also covers the following single variable course (College Board, 2016). Teachers are instructed to have students engage in Calculus concepts numerically, graphically, verbally, and analytically (AP Calculus

AB Course Overview, n.d.). The framework also recommends that students engage in the Mathematical Practices for AP Calculus students, which were developed with the work done by the National Council of Teachers of Mathematics and the Association of American Colleges and Universities (College Board, 2016). The practices include: a) Reasoning with definitions and theorems, b) Connecting concepts, c) Implementing algebraic/computational processes, d) Connecting multiple representations, e) Building notational fluency, and f) Communicating. The intention of the practices is for students to apply mathematics tools and make connections across the mathematics.

The Statistics course is non-calculus based and comparable to one semester of college statistics. Teachers introduce students to four main concepts: a) Exploring data: describing patterns and departures from patterns, b) Sampling and experimentation: planning and conducting a study, c) Anticipating patterns: exploring random phenomena using probability and simulation, and d) Statistical inference: estimating population parameters and testing hypothesis (College Board, 2010). Teachers are encouraged to have students learn content via collaborative, project based, exploratory, and technology-based activities. The hope of this course is that students make connections between the statistics and the real world.

Educating the Gifted

A myth of working with GT individuals is that they will find success on their own (Richert et al., 1982). Instead, the GT sometimes lack motivation and underachieve when not engaged in special programs or receiving differentiated experiences in the classroom that meet their needs (Bernal, 2003; Lubinki & Benbow, 2006; Marland, 1971; Richert et al., 1982). For secondary education, the Advanced Placement program is viewed as a program for GT students, but these students are four times more likely to enroll in an AP class that does not meet their

talents, possibly due to the college credit awarded or to boost their college admission chances (Clark, Moore, & Slate, 2012). In Hertberg-Davis and Callahan's (2008) study, they found that of the 28 students who dropped out of the AP program, 24 of them dropped out because the AP curriculum and instruction was too rigid and did not allow for multiple pathways to learning.

Education of GT students requires provisions that may vary from one GT student to another and differ from course to course (Davidson et al., 2004; Tannenbaum, 1983). For successful programs for GT students, and really all students, there exist three objectives for educators to meet:

1) GT students should grasp concepts that are at their level of ability in diverse contents.
2) GT students should acquire strategies and skills which allow them to be creative, independent, and pursuers of knowledge.
3) GT should be excited and joyful about learning, so that they are motivated during the route moments of learning (Gallagher & Gallagher, 1994).

Meeting these goals requires educators to focus less on the accumulation of knowledge and place an emphasis on creativity and active problem-solving techniques (Bernal, 2003). Specifically, for gifted mathematics students, the curriculum must allow for abstractness, complexity, depth, and breath (Poli, 2018). To accomplish these goals, GT learners need to be challenged in their coursework, the learning needs to appeal to them for motivational reasons, and they need choices in the learning process and products. Really, this amounts to good teaching for all students.

To effectively work with gifted learners in these capacities, teachers must be well trained on differentiation and its strategies because teachers assume the primary role in design and implementation of curriculum (Bernal, 2003; Greenes & Mode, 1999; Laine & Tirri, 2016). To begin training of teachers, Tomlinson (2014) recommends that differentiation must be defined

and illustrated and opportunities for discussion must exist. Following initial teacher professional development, teachers can engage in watching instructional videos, reading relevant literature, observing colleagues, and participating in small-group sessions to continue their learning about working with the GT (Lewis & Batts, 2005; Tomlinson, 2014). Teachers must then take time to reflect and make sense of differentiation and its application to their own classrooms (Tomlinson, 2014). In researchers Lewis and Batts' (2005) school, after professional development teachers took the time to highlight student success following the differentiated lessons, providing teacher reflection following the instructional modifications, and faculty created written expectations for differentiation. The more guidance given to the teachers the more prepared the teachers were to alter their classroom practices.

Trainings in GT education at the school site are necessary, for most teachers "receive little training or support beyond a single one-day or whole school workshop" (Hertberg-Davis, 2009, p. 252) and are expected to differentiate on a daily basis for all students. Likewise, teacher education programs need to prepare teachers to differentiate for all students. Schools need to provide opportunities for teachers to share ideas and support each other in strategies for differentiation (California Department of Education & the California Association for the Gifted, 1994). Following brainstorming and sharing sessions, additional support, coaching, and proof of the successful changes from the differentiation should be provided to faculty (California Department of Education & the California Association for the Gifted, 1994). With the needs of so many different learners in all classrooms, including Advanced Placement classrooms, teachers need continual support from professionals in the field.

The College Board recognizes that without great Advanced Placement teachers and their dedication to the program that students would not do well, but for teachers to be successful they

need support from the College Board (College Board, 2001). To teach a course in the AP program, teachers are not required to have any training in working with GT students (Clark, Moore, & Slate, 2012). However, if teachers of the GT had three to five graduate level courses in teaching the GT, they were found to be more effective in creating experiences that enriched their GT population's educational experience (Davidson et al., 2004). Davidson, Davidson, and Vanderkam (2004) argue that for schools to meet the needs of GT students, they need to be encouraged through differentiation in the classroom and outside the classroom through acceleration options.

Acceleration provides a cost-effective method for matching student ability to coursework (Heim, 1998; Siemer, 2009). Advanced Placement courses in themselves are considered an acceleration option because the courses teach material for entry level college courses and may provide college credit upon admission (Clark, Moore, & Slate, 2012). However, to get to the point where students have the option to take these courses, students have typically experienced an "accelerated program" where the same material has been covered in the classrooms, just at a faster pace than originally designed by the standards issued by the state (Sheffield, 1999). Students in these settings do not get to "explore, extend, and enjoy the mathematics they are learning" (Sheffield, 1999, p. 46), but rather continue to encounter routine and replication experiences. Students in these courses are learning more material, but rarely see modifications that grow their creative and intellectual gifts (Bernal, 2003).

Appeal. To find enjoyment, joy, and interest in learning is pivotal for student motivation in the process (Gallagher & Gallagher, 1994). Appeal in learning can be found when teachers create experiences that are enjoyable and engaging for GT students (Gentry & Owen, 2004). For many students, the interest in learning a concept comes from making personal connections to the

material and seeing the career paths associated with the concept studied (Gentry & Springer, 2000; Kaplan et al, 2016; Tannenbaum, 1983; Tredick, 2009). Part of the enjoyment of learning for GT students, and for all learners, comes from the challenge of the learning and the curiosity of the unknown (Gentry & Springer, 2000). Students need to see the beauty of mathematics and experience the joy of mathematics while exploring and developing mathematical concepts to find appeal in the subject (Sheffield, 1999). Instead, in many classrooms GT students become frustrated and board, leading ultimately to disliking mathematics (Chval & Davis, 2009).

One method towards finding appeal in the learning concepts is through independent projects, the use of self-instructional materials, or independent study of concepts within GT students' area of interest and talent (Rogers, 2007). The pursuit of their own interests encourages students to study in-depth topics that appeal to them while developing critical and creative thinking skills (Rogers, 2007; Tannenbaum, 1983). In addition, students get the feeling they are progressing in their learning and not replicating material they already have mastered (Davidson et al., 2004; Rogers, 2007).

Alternatively, teachers may plan tasks that meet the needs of all students through differentiating a task to provide points of access, learning, and appeal to each demographic grouping in the classroom. These tasks can accomplish the same learning goals for all students, but provide GT students the opportunity to demonstrate their knowledge and feel valued, but not-singled out, during lessons (Chval & Davis, 2009). Tasks such as these may involve discussions between heterogenous groupings of students, but they cannot be introduced to GT students as extra problems or extra work beyond the work their peers are doing (Chval & Davis, 2009). Creating opportunities for GT students to engage and enjoy mathematical learning will provide

positive academic achievement and positively impact enrollment in schooling beyond high school (Landis & Reschly, 2013).

Challenge. Educational equity requires providing each student a challenging education that meets their ability level (Davidson et al., 2004). High-ability learners in mathematics, such as GT students, need to be challenged through problem solving tasks where the answer is not easily seen and they must think freely on their possible approach to solving the problem (Gentry & Springer, 2002; Saul, 1999). GT students need opportunities to grow their stamina in their perseverance in solving challenging problems (Gentry & Springer, 2002; Gentry & Owen, 2004; Krist, 1999). Challenging problems help GT students to cultivate their high-level thinking skills, while also providing opportunities to advance their metacognitive skills, feelings of ownership, motivation, and engagement levels (Chval & Davis, 2009; Matsko & Thomas, 2014). Students should want to find joy in solving the challenging tasks previously seen as unsolvable (Krist, 1999). Classrooms that offer challenging curriculum and instruction with an emphasis in depth and complexity breed the greatest rewards for GT learners (Hargrove, 1999). When students are regularly challenged in classrooms, their achievement levels show an increase of one-third to three grade levels, as well as improved scores on assessments and more motivation for learning (Rogers, 2007). Without these experiences in classrooms, GT students become bored, frustrated, and unmotivated (Gentry & Springer, 2002; Gentry & Owen, 2004).

The Common Core State Standards were developed to be rigorous and more in depth, yet they do not offer enough depth and complexity for the advanced student (Assouline et al., 2015). Mathematics programs for the GT should challenge students through exploration of patterns and connection-making between concepts studied in mathematics and other courses (Sheffield, 1999). A regular classroom environment, in the absence of interventions for advanced students,

provides little challenge for students who already mastered the content and skill or can learn the material at an above average pace (Chval & Davis, 2009; Plucker & Callahan, 2014).

Providing learning choice. With curriculum maps, state standards for content, and mandated state testing, the focus of classrooms is on covering content and assuring that students replicate that information. With a mind shift towards using data gathered via systematic measurement in the RtI process, teachers can make instructional decisions based on the needs of the students and students can make choices about their own learning (Brown, 2012; Gentry & Owen, 2004). The instructional choices may include changes in the literature and resources used to teach the content, the activities utilized to have students gain an understanding of the material, or the way in which students demonstrate their learning (Lewis & Batts, 2005; Tomlinson, 2014). Matsko and Thomas (2014) argued that providing opportunities for students to use choice in the creation of mathematical problems to solve provides intrinsic motivation to continue to learn and deepen levels of engagement.

Adaptations can be made for all learners, gifted or struggling, and can be used as a means for motivation (Gentry & Springer, 2002; Gentry & Owen, 2004). Brown (2012) suggested that advanced students benefit from in-depth investigations on topics of interest. Laine and Tirri (2016) make an argument for compacting the curriculum to allow for advancement in the content. The gifted students in Fisher and Frey's (2012) study recommended that teachers be aware of the homework they assign, suggesting that homework is limited to critical information with real-world applications, not mere busy work. Tomlinson (2014) argued that to pick assignments fit for students, teachers must be aware of the student's readiness, interests, and learning style. Sheffield (1999) suggests that GT teachers provide enrichment activities that are tied to the objectives in the curriculum, but also allow GT students to be creative, reason

complexly, and make connections between concepts. Each of these ideas provides students options of the content to be studied, the process in which the material is learned, or the final product to document the learning process.

Differentiation for the gifted. In thinking about creating learning experiences for each child, teachers must place importance in defining the who – the student's interests and abilities, the what – the content to be learned, the how – the methods used to teach, and the where – the student groupings and the setting (Kaplan, 2008; Yang, 2012). These four pieces define the idea of differentiation for learners and are crucial to individualizing curriculum for all learners, especially GT learners (Kaplan, 2009). To accomplish the individualized curriculum, teachers can adjust the content, process, and product to respond to the curiosity and needs of the learner, while also fostering engagement and creativity of the students (Beasley & Beck, 2017; Gentry & Owen, 2004; Kaplan, 2008; Kaplan, McComas & Manzone, 2016; Tredick, 2009). With modifications in instruction and curriculum, opportunities exist for all students to "stretch and extend their knowledge and skills" (California Department of Education & the California Association for the Gifted, 1994, p. 7) allowing for discovery and nurture of each child's individual academic talent. Differentiation is not a strategy just for the GT population of students, but also a technique suitable for the success of all learners (Kaplan, 2013; VanTassel-Baska, 2003). With the lack of funding and pull-out or tracking programs in school, differentiation for all learners is a necessity (Cross, 1999).

Leta Hollingworth was at the forefront of the movement for differentiated instruction for the gifted (Coleman, 1999). Hollingworth's work in 1926 discussed modifications in instruction to benefit GT students. Too often the only attempt at differentiating in a mathematics classroom is by the number of problems students are assigned or the number of digits in numerical values

included in problems, which for many GT students is seen as busy work (Greenes & Mode, 1999; Hertberg-Davis, 2009). Students are still drilled through repetition even if the understanding is evident (Hollingworth, 1926). Instructional techniques such as these focus on the nongifted learner with an emphasis on the basics of knowledge, comprehension, and application at the bottom on Bloom's taxonomy (Tannenbaum, 1983). Gifted and talented students in mathematics would prosper more from exploration of advanced concepts in either a group or individual setting that allows the choice of product and is open-ended in where the learning may take them (Greenes & Mode, 1999; Hollingworth, 1926). Appeal and challenge in their courses could come from applying the mathematics to real world applications through service learning, as they tackle problems in their community, or through further research (Bernal, 2003; Hollingworth, 1926; Lewis, 1996; Renzulli, 2000). An important aspect of these projects and experiences is that students have a choice in the topic and the method in which the learning is completed (Renzulli, 2000). These experiences move the learning to a higher-level focusing on analysis, synthesis, and evaluation in Bloom's taxonomy (Tannenbaum, 1983).

A key component of differentiation for teachers is understanding that students vary and teachers must find ways to engage all learners (Tomlinson, 2014). In applying differentiation for the gifted population, teachers must comprehend that the needs of the gifted cannot be met with one program for all gifted learners, but variation needs to occur for each advanced student (Hertberg-Davis, 2009; Laine & Tirri, 2016). The gifted field "does not endorse any one approach to serving the students because of the range of student abilities and resulting concomitant diverse needs" (Brown, 2012, p. 106). Each gifted child has a different intellectual ability that requires alternate educational programming and classroom experiences to ensure their needs are met (Davidson et al., 2004).

Differentiation of pace, intensity, and complexity is essential for the gifted population needs to be met (Brown, 2012); making differentiation the most pervasive teaching tool for working with the advanced learners (Laine & Tirri, 2016). Although differentiation can engage the talents of advanced learners, educators must remember that it is one tool available in the continuum of services for gifted students (Hertberg-Davis, 2009). Therefore, teachers in high school classrooms need reminding and reinforcement that differentiation is as essential for struggling learners as advanced learners and that the tiers of the RtI model are indeed different levels of differentiation.

Differentiation strategies for use with gifted and talented students. To assist advanced learners towards showcasing their talents and not stagnate their potential, teachers should utilize a variety of strategies in the classroom tailored to the interests and needs of students (Fisher & Frey, 2012). In the realm of GT education, many specific strategies have been researched, utilized, and touted by educators and authors (Fisher & Frey, 2012; Gallagher & Gallagher, 1994; Kaplan, 2008; Laine & Tirri, 2016; Lewis & Batts, 2005; Park & Oliver, 2009; Schmitt & Goebel, 2015; Seedorf, 2011; Tomlison, 2014; Tredick, 2009). Seedorf (2011) recommends differentiation similar to that for struggling learners as outlined in the Response to Intervention model. Laine and Tirri (2006) describe these modifications as including different assignments, lessons, pacing, compacting the curriculum, and using flexible groupings. Learning centers, independent contracts, adjusted questions, thematic units, compacting of curriculum, tiered assignments, product options, and peer tutoring are other methods mentioned in the literature (Lewis & Batts, 2005; Park & Oliver, 2009). Fisher and Frey (2012) found that gifted students preferred teachers to model their thinking process, student accountability in all collaborative learning environments, and for homework to focus on practicing only known ideas. However,

paramount to developing activities to provide learning opportunities is ensuring engagement of the students. Schmitt and Goebel (2015) recommend integrating real-world connections in the tasks provided and grouping high-ability students with their intellectual peers to keep engagement levels high. There is a need to bring together the bright minds at some points so they can use each other as a resource in their learning (Davidson et al., 2004; Saul, 1999). Tomlinson (2014) provides several strategies such as stations, agendas, complex instruction, orbital studies, centers, tiered activities, entry points, learning contracts, small-group instruction, compacting, choice boards, literature and discussion circles, and jigsaw. With these strategies, Tomlinson (2014) suggested monitoring student progress and then personalizing instruction as needed throughout the lesson, for there is not one strategy that will always work for each student. Brown (2012) argues that gifted learners benefit from compacting, enrichment opportunities, and an emphasis on conceptual learning. Gifted learners themselves suggested they were successful when teachers modeled their thinking, allowed for cooperative learning with teachers holding all students accountable, and when they received guided instruction with homogenous peers (Fisher & Frey, 2012). Laine and Tirri (2016) emphasized a need for separate or small group instruction with flexible grouping as needed.

A strategy gaining popularity is based in Dr. Sandra Kaplan's Depth and Complexity prompts. The California Department of Education and the Association for the Gifted (1994) articulated and defined the concepts of depth and complexity breaking them into eleven concepts: Language, Details, Patterns, Trends, Unanswered questions, Rules, Ethics, Big ideas, Over time, Points of view, and Disciplinary connections (Kaplan, 2008). Kaplan later took these definitions and created visual graphics to represent the thinking curriculum of depth and complexity (Kaplan, 2008; See Figure 9). Moving through the depth and complexity prompts

from the eight dimensions of depth to the three dimensions of complexity encourages students to connect between ideas and to see the relationships between topics covered in different disciplines, as well as facilitate the individual and differentiated study of material (Kaplan et al., 2016). The prompts provide teachers with a framework for students to dig deeper and make connections between concepts, as necessary in differentiating for GT learners. Successfully implementing the depth and complexity prompts requires that the prompts be embedded with the targeted skills and the content of the discipline (Kaplan et al., 2016). The prompts should give learners a chance to transition from depending on the teacher for the learning experience to more of a student-directed experience (Kaplan, 2013). Instructors must make crucial decisions on when and how to introduce the depth and complexity prompts to allow for application and assimilation of the material (Kaplan, 2013). Part of those decisions may include conversations with the students on the strengths and challenges each individual child faces and the possibility of assignments differing between students based on their needs to reach success (Tredick, 2009).

ICONS	PROMPT	KEY QUESTIONS	THINKING SKILLS	RESOURCES
	LANGUAGE OF THE DISCIPLINES	What terms or words are specific to the work of the ________ (disciplinarian)? What tools does the ________ (disciplinarian) use?	▪ categorize ▪ identify	▪ texts ▪ biographies
	DETAILS	What are its attributes? What features characterize this? What specific elements define this? What distinguishes this from other things?	▪ identify traits ▪ describe ▪ differentiate ▪ compare/contrast ▪ prove with evidence ▪ observe	▪ pictures ▪ diaries or journals ▪ poetry
	PATTERNS	What are the reoccuring events? What elements, events, and ideas are repeated over time? What was the order of events? How can we predict what will come next?	▪ determine relevant vs. irrelevant ▪ summarize ▪ make analogies ▪ discriminate between same and different ▪ relate	▪ time lines ▪ other chronological lists
	TRENDS	What ongoing factors have influenced this study? What factors have contributed to this study?	▪ prioritize ▪ determine cause and effect ▪ predict ▪ relate ▪ formulate questions ▪ hypothesize	▪ journals ▪ newspapers ▪ graphs ▪ charts

ICONS	PROMPT	KEY QUESTIONS	THINKING SKILLS	RESOURCES
	UNANSWERED QUESTIONS	What is still not understood about this area, topic, study, or discipline? What is yet unknown about this area, topic, study, or discipline? In what ways is the information incomplete or lacking in explanation?	▪ recognize fallacies ▪ note ambiguity ▪ distinguish fact vs. fiction and opinion ▪ formulate questions ▪ problem solve ▪ identify missing information ▪ test assumptions	▪ multiple and varied resources ▪ comparative analyses of auto-biographical and current nonfiction articles, etc.
	RULES	How is this structured? What are the stated and unstated causes related to the description or explanation of what we are studying?	▪ generalize ▪ hypothesize ▪ judge credibility	▪ editorials ▪ essay ▪ laws ▪ theories
	ETHICS	What dilemmas or controversies are involved in this area, topic, study, or discipline? What elements can be identified that reflect bias, prejudice, and discrimination?	▪ judge with criteria ▪ determine bias	▪ editorials ▪ essays ▪ autobiographies ▪ journals
	BIG IDEAS, GENERALIZATIONS, PRINCIPLES, AND THEORIES	What overarching statement best describes what is being studied? What general statement includes what is being studied?	▪ prove with evidence ▪ generalize ▪ identify the main idea	▪ quotations ▪ discipline-related essays
	OVER TIME	How are ideas related between the past, present, and future? How are these ideas related within or during a particular time period? How has time affected the information? How and why do things change or remain the same?	▪ relate ▪ sequence ▪ order	▪ time lines ▪ text ▪ biographies ▪ autobiographies ▪ historical documents
	DIFFERENT POINTS OF VIEW	What are the opposing viewpoints? How do different people and characters see this event or situation?	▪ argue ▪ determine bias ▪ classify	▪ biographies ▪ autobiographies ▪ mythologies and legends vs. non-fiction accounts ▪ debates
	Interdisciplinary	How are these subject areas related? What idea connects these areas?	▪ Relate ▪ Justify ▪ Associate ▪ Correlate	▪ print and non-print references ▪ Fiction and non-fiction

Figure 6. Depth and Complexity Prompts (Kaplan, 2013, p. 279). From *Fundamentals of gifted education: Considering multiple perspectives* by C. M. Callahan and H. L. Hertberg-Davis, 2013, New York, NY: Routledge. Reproduced with permission of Routledge in the format Thesis/Dissertation via Copyright Clearance Center.

Keeping GT learners active in the classroom can be done through structured discussion, mutual investigation into a task, as well as using open-ended questioning or prompting techniques that require students to think deeply and make connections across content, disciplines,

and real-world applications (California Department of Education & the California Association for the Gifted, 1994; Gallagher & Gallagher, 1994). Utilizing the thinking skills involved in answering and asking higher level questions results in more significant comprehension of coursework and forcing students to think deeply about issues while exploring concepts from many directions (Tredick, 2009; VanTassel-Baska, 2003). These instructional strategies require students to extend or broaden their knowledge (complexity) and to focus more "attention on increasingly more difficult, divergent, and abstract qualities of knowing a discipline" (depth; Kaplan, 2008, p. 118).

To provide opportunities for students to go deeper and look at more complex problems within content areas, teachers should provide opportunities for students to adopt the roles of professionals, such as architects, archeologists, chemists, engineers, historians, etc. (California Department of Education & the California Association for the Gifted, 1994). Thinking like an expert and assuming the role of an individual in the field, requires students to use the language, procedures, and classification system of that discipline (Tredick, 2009). Students might be identifying trends in economic patterns, looking for patterns in political maps, or describing each detail of cell division (Tredick, 2009). In science classes, teachers can require students to study the sciences from the expert's point of view via enquiry instruction while still meeting the learning goals of the course (Kaplan et al., 2016). The model of enquiry instruction is already used in many schools via the idea of science fairs, problem-based learning and modeling, but in many classrooms, teachers fall back on the idea of lecture which does not create a truly authentic view (Kaplan et al., 2016; VanTassel-Baska, 2003). Learning as a disciplinarian works well for the gifted population (California Department of Education & the California Association for the Gifted, 1994; Kaplan et al., 2016; VanTassel-Baska, 2003). In spite of the extensive list of

strategies, Hertberg-Davis (2009) finds that teachers tend not to differentiate instruction for GT students even though in small quantities, differentiation impacts student achievement and motivation levels.

Acceleration. Acceleration may be one of the most effective methods for meeting the needs of GT individuals, as well as financially viable methods due to its use of existing structures in schools (Assouline et al., 2015; Heim, 1998; Renzulli, 2000; Rogers, 2007; Siemer, 2009). It relies on that fact that GT students assimilate information quickly and acquire that information at a great depth of knowledge (Subotnik et al., 2011). Close to sixty years ago the Rockefellers Brothers Fund found that:

> Adequate attention to individual differences means rejecting a rigid policy of promotion by age, and it means sensible experimentation with various kinds of flexibility in the curriculum to meet the varying needs of young people. And especially, it means providing unusually able boys and girls with rigorous and challenging experiences. (Rockefeller Brothers Fund, 1961, p. 371)

The non-rigid promotion policy of acceleration implies that students may grade skip for their entire school day or join other classes during different parts of the day that meet their academic needs (Davidson et al., 2004; Subotnik et al., 2011). Although, moving a student to a course that is a few years ahead may not have the needed benefit for a GT student if the course is still taught at a superficial level without depth, complexity, choice, and challenge (Sheffield, 1999). Acceleration improves motivation, and confidence, prevents mental laziness, provides earlier entrance to more advanced opportunities, reduces costs at university and earlier entrance into the workforce (Gallagher & Gallagher, 1994; VanTassel-Baska, 2000).

Acceleration was very common in the 1800s in one-room school houses where students of all ages were grouped together, but by the late 1890s schools shifted towards grouping students by age (Colangelo et al., 2004; Sayler, 1999). In 1926, Leta Hollingworth argued that

students of high IQ can rapidly progress through elementary and secondary school to enter the work force at a young age and have more time to develop their professional expertise. However, her research fell on deaf ears until the launch of Sputnik in 1957 when grade skipping and acceleration were reintroduced so that the United States could use their GT individuals to contend with the Russians in the space exploration (Colangelo et al., 2004; Sayler, 1999). The Advanced Placement program is a means of acceleration for gifted students, but also provides acceleration options for the those not previously identified as gifted and talented (Colangelo et al.) Other forms of acceleration include:

1. Early admission to kindergarten
2. Early admission to first grade
3. Grade skipping
4. Continuous progress
5. Self-paced instruction
6. Subject-matter acceleration/partial acceleration
7. Combined classes
8. Curriculum compacting
9. Telescoping curriculum
10. Mentoring
11. Extracurricular programs
12. Correspondence courses
13. Early graduation
14. Concurrent/dual enrollment
15. Advanced Placement

16. Credit by examination
17. Acceleration in college
18. Early entrance into middle school, high school or college (Colangelo et al., 2004, p. 12)

Gifted and talented students who experience curriculum designed for older students through acceleration means have been shown to have positive achievement results and to experience positive results in their lives up to fifty years later (Gibson, 2017; Lubinki & Benbow, 2006; Steenbergen-Hu & Moon, 2011; Subotnik et al., 2011). Common methods of acceleration assist students in entering the career force at a younger age. For instance, an individual who desires to become a medical doctor most likely will not enter the profession until the age of twenty-nine or thirty after completion of schooling, internships, and residency (Gallagher & Gallagher, 1994). If a student were to complete schooling at an earlier age, the student would enter the workforce and have a longer time frame to find success in their chosen career.

However, acceleration is not always used due to difficulties in scheduling, for some students may need to attend classes on multiple school campuses (Southern & Jones, 2015; Subotnik et al., 2011). For some GT students, what any classroom, no matter at grade level or above, offers will not be enough to accelerate them to their potential, and outside summer and extracurricular programs will be needed for this type of development (Usiskin, 1999). Community acceptance of acceleration is not always high due to concerns around the social and emotional well-being of the students (Gallagher & Gallagher, 1994; Southern & Jones, 2015). However, Rogers (2015) found that the social and psychological effects of acceleration were

minimal, and the academic rewards were far greater. Therefore, acceleration seems a viable option to promote challenge, offer appealing courses and choice to gifted and talented students.

Summary

This chapter reviewed the educational equity theoretical framework and the policies that have led to more equity in education, but not necessarily for GT students. Introduced were historical progressions of GT policies in education, the Advanced Placement program, definitions of giftedness, and procedures for the identification of students as gifted and talented. The chapter concludes with a discussion of differentiation and acceleration as a means of meeting the needs of GT students in educational institutions so that courses appeal to them, challenge them, and provide learning choice.

Chapter 3: Methodology and Procedures

Research Design and Rationale

This quantitative, comparative, and quasi-experimental study examined the phenomena of the high school students' current perceptions of appeal, challenge, and learning choice in high school AP mathematics courses in the affective domain using portions of the Student Perceptions of Classroom Quality (SPOCQ) instrument (Gentry & Owen, 2004). This research approach was designed to allow for a comparison of the perceived perceptions of students previously identified as GT versus a matched group of students not previously identified as GT who were currently enrolled in AP mathematics courses to examine the equity of educational experiences for all students in the pursuit of having each individual reach their highest potential. In this study, appeal referred to students' interest and enjoyment of the AP math course, while also reflecting the safe, satisfying, and engaging classroom environment. Appeal was measured using seven items on the SPOCQ instrument. Challenge indicated students participating in effective learning involving depth, complexity, rigor while examining math content, processes, and products. Challenge was measured using seven survey questions from the SPOCQ instrument. Learning choice referenced students leading decisions about their learning to take ownership and increase motivation. Learning choice was measured using seven questions on the SPOCQ instrument.

For cost-effective purposes and ease of data analysis, a self-reporting internet questionnaire was employed to cross-sectionally gather data at the interval level for each of the phenomena studied. Students previously-identified as GT and non-identified GT who were currently enrolled in AP mathematics courses of AP Calculus AB, AP Calculus BC, and AP Statistics completed the questionnaire between the two-week period of May 15, 2019 and May 29, 2019, to allow for a majority of students' AP experience in the survey results. During this

time period, students were taking AP exams for their mathematics courses, if they have elected to do so, along with other AP exams. A majority of students enrolled in these courses were in eleventh and twelfth grade. Students who dropped out of the course at any point during the school year were not eligible for participation in this study for those students had not have experienced a majority of the course.

Population, Sampling, Assignment, and Expected Response

The population of interest in this study was comprised of students enrolled in Advanced Placement Mathematics courses in four public high schools located in a single Southern California School District. The inclusion criteria comprised of enrollment as a student in the high school of study and enrollment in one of the three AP mathematics courses offered: Statistics, Calculus AB, and Calculus BC. The two Calculus classes typically represent the first and second semester of college level Calculus, respectively. The Calculus BC course framework includes all of the content included in the Calculus AB framework with the addition of one unit of study and a few additional topics. The Statistics course is also equivalent to one semester of an introductory non-Calculus college level Statistics course. Therefore, the three courses are all introductory college level courses with a similar level of difficulty. Exclusion criteria included students who did not possess all of these inclusion characteristics, for example being enrolled in a non-AP Statistics class. The high schools involved in this study included the four public high schools (identified in this dissertation via pseudonyms) which were located in a suburban school district in Southern California (See Appendix B for a data summary): W High School (WHS), X High School (XHS), Y High School (YHS) and Z High School (ZHS).

As shown in Appendix B, in the 2017-2018 school year, WHS had 2042 students with 397 students receiving free or reduced meals, 158 English Language Learners, 37.8% white,

30.1% Asian, 17.5% Hispanic, 6% two or more races, 3.4% Filipino, 2.2% African American or Black, 0.3% Native Hawaiian or Pacific Islander, and 0.2% American Indian or Alaska Native (EdData, 2018). XHS, in 2017-2018, had 2031 students with 458 students receiving free or reduced meals, 147 English Language Learners, 36.9% Asian, 23.2% white, 20.1% Hispanic, 8.1% two or more races, 4.1% African American or Black, 5.3% Filipino, 0.2% American Indian or Alaska Native, and 0.1% Native Hawaiian or Pacific Islander (EdData, 2018). The 2017-2018 school year saw YHS with 1954 students with 677 students receiving free or reduced meals, 192 English Language Learners, 41.2% Hispanic, 18.1% Asian, 16% white, 11.8% Filipino, 6.6% two or more races, 3.7% African American or Black, 0.5% Native Hawaiian or Pacific Islander, and 0.4% American Indian or Alaska Native (EdData, 2018). ZHS enrollment in 2017-2018 included 1846 students with 816 students receiving free or reduced meals, 169 English Language Learners, 42.7% Hispanic, 25.1% Asian, 12.4% white, 7% African American or Black, 5.6% two or more races, 4.9% Filipino, 0.8% Native Hawaiian or Pacific Islander, and 0.1% American Indian or Alaska Native (EdData, 2018).

In eleventh grade students at each high school take the California Assessment of Student Performance and Progress (CAASPP), which contains a performance task and a computer adaptive test based on the Common Core State Standards for California ("CAASPP Description – CalEdFacts", 2018). Students receive a performance indicator of Standard Exceeded, Standard Met, Standard Nearly Met, or Standard Not Met. Students are scored based on their mastery of four claims: a) Concepts and Procedures, b) Problem Solving, c) Communicating Reasoning, and d) Modeling and Data Analysis. See Table 4 for a summary of student mathematics scores from the May 2018 administration of the CAASPP at each of the high schools in this study (EdData, 2018).

Table 4

Summary of students' results on the Mathematics CAASPP taken in May 2018

	Percentage of 11th graders at the school who received the performance indicator			
School	**Standard Exceeded**	**Standard Met**	**Standard Nearly Met**	**Standard Not Met**
WHS	34.6%	31.0%	21.1%	13.3%
XHS	31.7%	26.5%	20.7%	21.1%
YHS	21.9%	30.8%	25.2%	22.1%
ZHS	13.2%	24.8%	29.7%	29.3%

For the 2018-2019 school year, WHS had a total of 142 students enrolled in the AP mathematics courses, with 38 of those students coded as being previously identified as GT. XHS had a total of 225 students enrolled in the three AP mathematics courses offered, with 114 of those students coded as being previously identified as GT. YHS did not offer the AP Statistics course this school year, but the two Calculus courses had a total of 115 students enrolled with 41 students identified as GT. In the three AP mathematics courses identified, ZHS had 130 students enrolled with 45 students previously identified as GT. Therefore, this study's population of interest comprised 612 students with 238 of those previously identified as GT. In May 2019, students enrolled in these courses had the option of sitting the AP exam to show their knowledge of the curriculum.

Students are given scores of 5, 4, 3, 2, and 1 on the Advanced Placement exam. A score of a 5 means the student is extremely well qualified and capable of doing the work required in the subject at a college or university ("About AP Scores", n.d.). Subsequently, a 4 means well qualified, a 3 qualified, a 2 possibly qualified, and a 1 means no recommendation ("About AP Scores"). The May 2019 scores were released to students and teachers in July 2019, thus these

scores were not included in this study. See Table 5 below for summarized results from the May 2018 AP mathematics courses in this study at each of the schools of interest.

Table 5
Summary of students' results on the AP Mathematics Tests of Calculus AB, Calculus BC, and Statistics taken in May 2018

	Number of total students who received each score					**Average AP Score**
School	**5**	**4**	**3**	**2**	**1**	
WHS	74	35	26	10	5	4.087
XHS	82	46	54	23	6	3.829
YHS	Could not attain this school's data					
ZHS	16	31	34	30	26	2.861

The sampling frame was non-probabilistic total population sampling with matching done after the demographics are known of the respondents. Students were recruited to participate via their AP mathematics teachers, who the researcher coordinated distribution and collection of the hardcopy parental consent forms, as well as the distribution of the link to the online survey. Parents were asked to write their name on the hardcopy parental consent form to allow for verification of consent by parents to the AP teacher. The landing page of the digital questionnaire included an assent form for students to accept or decline participation. Using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) to compute an a priori power analysis, in order to detect a medium sized effect between two groups on three response variables with 80% power and a significance level of 0.05, a minimum sample size of 180 students in a balanced design, was necessary for the analytic method planned (MANOVA). Therefore, for data analysis, students were grouped non-randomly using matched pairs with pre-existing conditions identified via the demographic section of the instrument where participants identified themselves as previously identified as GT or not. Specifically, student demographics identified in the data

set with demographic matching of similar students was done prior to statistical analysis. The response rate was expected to be at least 32% due to the need for parental consent and the online survey format, which would yield a sample size that would be minimally sufficient towards the planned inferential analysis. The actual response rate was 44%.

Human Subjects Considerations

The school district's Chief Academic Officer first provided approval to seek school and parent or guardian permission to have students take the online survey after reviewing the researcher's school district research application (See Appendix C). Second, Pepperdine University's Institutional Review Board (IRB) verified participants' confidentiality, minimal risk, and fair administration during survey administration (See Appendix D). Third, each parent of a potential student received an informed consent via their child describing the study and requesting permission for the student to participate if they desired. Finally, students were given a choice to assent to take the survey. The process for obtaining consent for eligible children who did elect to participate is described below.

The landing page of the online survey included the role of the participants in the study, the purpose of the research, the descriptions of the procedures, potential risks and benefits, contact information for further questions, confidentiality information, and the choice of assent or decline of participation in the survey. Survey results are kept password protected on the online survey tool and will be destroyed three years after the study. Parents' signed consent forms are being held in a locked safe at the researcher's home. At the bottom of the landing page, students had the choice to accept the assent information and continue or cancel and decline participation. The Student Perceptions of Classroom Quality (SPOCQ; see Appendix A) instrument used in this study was copyrighted by authors Gentry, Owen, and Springer, but is available for research

use without prior permission ("Gifted Education Resource Institute Instrument Repository: Student Perceptions of Classroom Quality (SPOCQ)", n.d.).

Minimal risks for participants included looking more in-depth at the AP mathematics course and the instructional techniques used in the classroom. This may have led to dissatisfaction with the coursework and eventually a lack of engagement or participation. Participants may have felt boredom and fatigue. Participants may also have experienced boredom and fatigue. Socially, participants may have lost respect for their teacher if they deemed that the course was not appealing, challenging or offered choice or participants may feel embarrassed for being or not being labeled gifted and talented. Participants may also have experienced harm if a breach of confidentiality or breach of identification occurred, but it did not. These breaches of confidentiality and identification are likewise legal risks for the students.

To minimize psychological risks, there was no time limit on the survey. To minimize social risks, the survey was given near the end of course work so students did not have much further course work with the teacher. The demographic data collection is where students identified themselves as gifted and talented, but they also had the option to select other services they received at school, if any, such as English as a second language or English Language Learner, Speech, Hearing, Special Education - Learning disability, Special Education - Behavioral services, or Free or Reduced Lunch. This minimized the risks for participants to feel socially labeled because there were many choices to choose from. To minimize risks of a breach of confidentiality and a breach of identification, all data collected was de-identified. Any identifiable information obtained in connection with this study remained confidential. When the results of this project were presented, the names of the participants and schools in the study were

not revealed. Participants and the schools were assigned pseudonyms to maintain confidentiality.

The records collected for this study were confidential as far as permitted by law. However, if required to do so by law, it may have been necessary to disclose information collected about participants if the participant disclosed any instances of child abuse or harm to self or others.

Participants did not directly benefit from this study, though the societal benefits include those addressed in “Importance of the Study” in Chapter 1 of this manuscript. In addition, the findings from this study may contribute to the knowledge surrounding the needs of identified GT students in AP mathematics classrooms benefiting future gifted students.

The researcher currently teaches in the AP mathematics program in the district where the study is being conducted. However, the design of the research did not impact student grades or eligibility for any other programs. Therefore, the potential conflict of interest was low.

Measures

The Student Perceptions of Classroom Quality (SPOCQ) instrument, created by Gentry and Owen (2004), was designed to gather student attitudes on appeal, challenges, learning choices, self-efficacy, and the meaningfulness of their educational experiences (see Appendix A). Through the student perception data gathered via the SPOCQ, Gentry and Owen hope that educators and researchers alike can focus on strategies to improve educational experiences for the GT as well as their grade level peers not identified as GT. The SPOCQ was intended for use with secondary students to measure student affect to guide instructional choices in curriculum and instruction. The SPOCQ built on a previous instrument, My Class Activities, and a pilot study in which Gentry also conducted (Gentry & Owen, 2004). The pilot study employed "22

content experts who rated items written for each construct" (Gentry & Owen, 2004, p. 22), and then piloted the instrument with 500 high school students. Following the pilot, revisions were made to the tool including rewording of statements, adding four attribution items, and including self-efficacy items as part of the five constructs. A confirmatory factor analysis identified five correlated, but sufficiently independent constructs with no second order factor measuring classroom quality (Gentry & Owen, 2004).

The SPOCQ survey measured five subscales including appeal, challenge, choice, meaning, and self-efficacy. Students respond to 38 questions using a 5-point Likert scale ranging from *strongly disagree* (1), *disagree* (2), *undecided* (3), *agree* (4), to *strongly agree* (5). There are seven questions each on appeal, challenge, and choice, while the meaning construct utilized five questions and self-efficacy statements number eight. This study looked at the 21 questions on appeal (items 3, 9, 19, 20, 25, 26, 31), challenge (items 4, 8, 11, 15, 18, 27, 33), and choice (items 1, 5, 6, 12, 16, 17, 22). Items related to meaning and self-efficacy items were excluded from the questionnaire because they were not part of the stated research question, and in order to decrease the number of items that participants were asked to respond to or complete. The SPOCQ was free to use for research and classroom use, and initial administration employed paper and pencil. However, for this study the researcher converted the SPOCQ to digital means to be completed in an online format.

The SPOCQ instrument included seven items related to appeal, seven items related to challenge, and seven related to learning choice. Each item was scored from one to five with the arithmetic means gathered for each subscale. For the appeal subscale, scores of 2.35 or below were considered low, while 3.97 or above is high (Gentry & Owen, 2004). A mean score of 2.97 or below was considered low for challenge, while the high score would be 4.29 or above. An

arithmetic mean score in the choice subscale was rendered low at 2.89 or below and high at 4.19 or above.

To confirm reliability of the SPOCQ instrument, Gentry and Owen (2004) used SPSS v. 12 to generate alpha reliability coefficients and descriptive statistics. Gentry and Owen found the alpha estimates for the subscales as follows: choice (.81), academic self-efficacy (.82) appeal (.85), meaningfulness (.81), and challenge (.81). A confirmatory factor analysis (CFA) results produced a Bentler's Comparative Fit Index (CFI) of 0.997, which is greater than 0.95 and thus represented a good model fit to the data (Hooper, Coughlan, & Mullen, 2008). The root mean square error of approximation (RMSEA) of 0.051 [CI 0.048 - 0.055] likewise represented a reasonable fit of the data providing evidence of the instrument's construct validity. Gentry and Owen described these results as very strong.

In addition to the questions from the SPOCQ instrument, three additional questions were added to the survey (See Appendix D). The first additional question was included on the survey to provide student perceptions on the pacing of the AP class. The Calculus AB and Statistics courses cover material from one semester of a college-level mathematics course, while the Calculus BC course covers material from two semesters of college-level mathematics. Therefore, for two of the three courses, students were covering material at a slower pace than encountered at a university or college. The two other questions included address the researcher's previous connection to the RtI model and focus on the Tier 2 level interventions. These questions sought to find if the interventions enriched the curriculum of the course for students and if the interventions supported students to be successful in the course. Not all four of the high schools included in this study offered Tier 2 interventions for AP mathematics students, therefore, these questions were optional.

The SPOCQ instrument collected the following demographic information: the subject area in which the survey was completed, the level of course (advanced, AP, or honors, or neither), the school community location (rural, urban, suburban), grade, gender, ethnic group, grade in the current course, and services provided by the school district including gifted/talented. Most of this information was vital to gather to allow for stronger generalizability of the findings from the sample to that of the entire population and to assist in matching for data analysis. Therefore, for this study, the researcher collected demographic data on student gender, grade, ethnic group, first semester grade in the course, the AP mathematics course or courses enrolled currently, school of enrollment, services provided by the school district, and why the student enrolled in the AP course. This data was used for matching subjects based on their demographic similarity.

Data Collection Procedures and Data Management

Data collection occurred online via a Qualtrics survey (See Appendix D) at the four comprehensive high schools in a suburban Southern California school district: W High School (WHS), X High School (XHS), Y High School (YHS) and Z High School (ZHS). Before data collection, approval was gathered from Pepperdine University's Institutional Review Board (IRB), the school district's Chief Academic Officer, from each school's principal, and from each Advanced Placement mathematics teacher at WHS, XHS, YHS, and ZHS. The researcher emailed each high school principal to obtain permission to conduct the survey after school district permission was granted (See Appendix E). If no email response was obtained, the researcher sent a reminder email to each principal. Once permission from agreeing principals and IRB approval was obtained, the researcher emailed each teacher seeking permission to

survey their students and explained the process and time constraints (See Appendix F). If a response was not received, the researcher called each teacher.

Once permission was obtained from the previously listed personnel, the researcher delivered to each school site photocopies of the informed consent forms for parents (See Appendix G), written instructions for AP mathematics teachers (See Appendix H) and instructions for the potential participants (See Appendix I). Advanced Placement mathematics teachers were asked to help recruit participants on May 13, 2019, just following AP exams, by distributing to each potential participant a copy of an informed consent requesting permission for the student to participate in the described study. Participants were described to teachers as students currently enrolled in their AP courses, so as to exclude students who dropped out of the AP courses during the school year. Participants returned the informed consent signed by their parent or guardian and themselves to their AP mathematics teacher. All informed consent forms were gathered together for each school site and mailed back to the researcher via a pre-paid mailing envelope. Included in the mailing, AP teachers were asked to add a class list to confirm participants that had received consent. Informed consents, class lists, and the pseudonym codes for high school names are being stored in a locked safe at the researcher's home for three years when, at that time, the consents will be destroyed via hard-copy shredding. Upon collection of the informed consent, the AP mathematics teachers were instructed to pick a class day between May 15, 2019 and May 29, 2019, and then provide each participant with written survey instructions including the link and QR to the Qualtrics survey.

The researcher asked the participating AP teachers to remind their students to return the informed parental consent prior to May 15, 2019. The Qualtrics survey opened on May 15, 2019, and was closed by the researcher on May 29, 2019, at 11:59 pm. The researcher instructed

teachers to pick a date of their choosing in the two-week period to have students complete the survey during class time. Students who did not take the survey with the remainder of the class were instructed to complete other assignments at the direction of the teacher, thus the alternative to participation was non-participation. The researcher sent email reminders (See Appendix J) at 7:00 am on May 17, May 22, and May 28, 2019 to AP teachers to have students take the survey in class to increase participation outcomes. These dates were chosen for reminders because May 17th is two days after the survey opened, May 22nd is the middle of the following week, and May 28th is the day before the survey closes. Students who did not turn in the parent permission form prior to the class taking the survey, but turned it in later and prior to the closing date of the survey, were handed the directions (See Appendix I) provided by the researcher to the teacher with the survey link.

Participants were encouraged to use their personal electronic devices, such as a smartphone or laptop, to complete the Qualtrics survey in class. However, teachers were also asked to have Chromebooks or other internet connected devices available for student use if a personal device was not available. The teacher handed each student directions (See Appendix I), provided by the researcher, with the directions and a bit.ly link, as well as QR code, to the survey. Students keyed in the link on their electronic device to access the survey. The survey (See Appendix D) link opened with a welcome message, assent information, and a choice of assent or decline of participation. When students assented, a second page provided participants with instructions on how to complete the survey. Students who declined participation were led to a thank you page. For assenting students, the third page of the Qualtrics survey collected participant grouping demographic data of previously identified as GT or not, as well as other demographics (student gender, grade, ethnic group, first semester grade in the course, the AP

mathematics course or courses enrolled currently, school of enrollment, and services provided by the school district). Students completed the SPOCQ instrument questions on appeal, challenge, and learning choice in the order in which they were given in the instrument as originally designed. Qualtrics was programmed to present the assent form first, then the items related to appeal, challenge, and learning choice, and then demographics last. The directions with the survey link given to students were collected by the teacher after students completed the survey so as to be reused by other classes, if the teacher had multiple sections, and then returned to the researcher with the consent forms. With the collection of the survey link, participants were not able to share the link with others who were not enrolled in the AP mathematics courses at one of the four high schools in the study. The responses on Qualtrics were downloaded into a password-protected Excel document in order to create demographically matched pairs of students previously identified as GT or not. The reported data is not student-specific, but was analyzed and reported at the school, course, and overall level. Excel was also used to calculate the subscale scores for appeal, challenge and learning choice. All digital files are password-protected and will be kept indefinitely, but for at least three years to allow for potential re-analysis.

Data Analysis

The researcher hypothesized that there was a significant difference in perceptions of appeal, challenge and learning choice in high school AP mathematics courses between AP students who were previously identified as GT versus those who were not. Appeal, challenge, and learning choice are all outcome variables measured at the interval level using the Student Perceptions of Classroom Quality (SPOCQ; Gentry & Owen, 2004) instrument. See table 6 for a summary of the study's hypothesis and constituent variables.

Table 6

Summary of Study's Hypothesis and Constituent Variables

Alternative Hypothesis	Variable Name	Variable Type	Measure Name	Level of Measurement
It is hypothesized that there is a significant difference in perceptions of appeal, challenge and learning choice in high school AP mathematics courses between AP students who were previously identified as gifted and talented versus those who were not.	1a. Student Type (GT or not)	1a. Predictor	1a. self-report	1a. dichotomous
	1b. Appeal	1b. Outcome	1b. Student Perceptions of Classroom Quality (Gentry & Owen, 2004)	1b. Interval
	1c. Challenge	1c. Outcome	1c. Student Perceptions of Classroom Quality (Gentry & Owen, 2004)	1c. Interval
	1d. Learning Choice	1d. Outcome	1d. Student Perceptions of Classroom Quality (Gentry & Owen, 2004)	1d. Interval

The survey was completed by participants using the online Qualtrics instrument, which was set up to require participants to answer each question prior to submitting their responses to eliminate missing data. Data was downloaded to an Excel spreadsheet. Each row on the Excel document included one participant's responses to each of the questions on appeal, challenge, and learning choice ranked using the 5-point Likert scale ranging from *strongly disagree* (1),

disagree (2), *undecided* (3), *agree* (4), to *strongly agree* (5). Each column included all participants responses to each question. The Excel document allowed for inputting of the raw data to the statistical software, RStudio, to ease analysis and allow for the descriptive statistics of the interval level data to find the mean, median and standard deviation for each variable: appeal, challenge, and learning choice. This analysis also verified homogeneity of variance and normality, with non-normal data transformed to attain a normal distribution, if necessary. Outliers were deleted case wise from the dataset. Inferential statistical analysis was tested using one-way Multivariate Analysis of Variance (MANOVA) to distinguish if there were differences between the responses of the two groups for appeal, challenge, and learning choice. Effect size was measured using Cohen's *f* with values of .02 to <.15 considered small, .15 to <.35 medium, and >.35 as a large effect.

Chapter 4: Results

Introduction

The purpose of this quantitative, comparative, quasi-experimental study was to identify what differences, if any, existed in the perceived appeal, challenge, and learning choice in high school Advanced Placement (AP) mathematics courses between AP students who were previously identified as gifted and talented versus a matched group of those who were not. To examine the potential differences, twenty-one questions that covered perceptions of appeal, challenge, and choice from the original Student Perceptions of Classroom Quality (SPOCQ) survey, as well as a demographic questionnaire, was administered after the completion of the AP exam in May to students in one Southern California school district who were enrolled in the AP mathematics courses of Calculus AB, Calculus BC, and Statistics. This chapter examines the results of this survey to explore if any differences existed between the two populations of students in these accelerated, college-level courses.

Study Response Rate

In seeking the perceptions of previously identified as gifted and talented students and their non-identified peers in Advanced Placement classes, parental consent forms were distributed to the twelve teachers from the four high schools in this study. The intent was for each of the twelve teachers to distribute the parental consent forms to the 612 participants enrolled in AP mathematics courses in the school district. Four teachers did not distribute the parental consent forms, three of them from W high school, and one from Y high school. Therefore, the students of these teachers were eliminated from the participation pool. The remaining teachers all distributed and collected parental consent forms and administered the survey to students who submitted the forms. Two hundred seventy-nine responses to the survey

were received. Five of them were rejected because they were not completed, and three more chose not to participate via the student consent and were rejected, resulting in 271 responses suitable for analysis. The generated response rate was 44%, which met the minimum of 32% needed as discussed in chapter three. Table 7 displays the data concerning the survey. Of the 271 usable responses, 71 responses (26.2%) were from Z high school, 160 responses (59.0%) from X high school, and 40 responses (14.8%) from Y high school. No students from W high school participated in the study. Table 8 displays the response rates per each high school.

Table 7

Data Regarding Survey

Distributed	Returned	Rejected	Usable
612	279	8	271 (44%)

Table 8

Response Rates per Each High School

School of Enrollment	Frequency	Percentage
X High School	160	59.0
Y High School	40	14.8
Z High School	71	26.2

Demographic Characteristics of the Participants

This section contains a review of the demographic characteristics of the study's participants, as shown in Table 9. Of the 271 students who completed the survey, 123 (45.4%) were male and 148 (54.6%) were female. The majority of students who took the survey were in 12th grade (n = 204, 75.3%), with the remaining students enrolled in 11th grade (n = 67, 24.7%).

In regards to course enrollment for the participants during the 2018-2019 school year, 164 students (60.5%) took the AP Calculus AB course, 57 students (21.0%) took the AP Calculus BC course, 44 students (16.2%) took the Statistics course, 4 students (1.5%) took both Calculus AB and Calculus BC, and 2 students (0.7%) were enrolled in both Calculus AB and Statistics. In those courses for first semester, 112 students (41.3%) self-reported receiving an A as their grade, 89 students (32.8%) self-reported earning a B, 57 students (21.0%) self-reported getting a C, 9 students (3.3%) self-reported obtaining a D, and 4 students (1.5%) received a F. A majority of student study participants identified their ethnicity as Asian (n = 161, 59.4%), while the least represented ethnic populations were Pacific Islander (n = 1, 0.4%), Other (n = 3, 1.1%), African American (n = 4, 1.5%), and Filipino (n = 8, 3.0%). This is representative of the total population of these schools. Thirty-four students (12.5%) classified themselves as Caucasian, not of Hispanic origin, and 34 students (12.5%) recognized themselves as Hispanic or Latino. The remaining 26 participants (9.6%) submitted a response of Two or More Races. Students reported why they enrolled in the AP course in the demographic data portion of the survey. Most students reported that they enrolled because they had a desire to take the course (n = 128, 47.2%), they wanted to boost their college application (n = 111, 43.5%), and that they wanted to challenge themselves (n = 118, 43.5%). Few students reported that a parent or counselor forced them to enroll. Sixty (28%) of the respondents did state that they enrolled in the course because they really liked mathematics, while 66 (34%) survey responses stated that they took the course to boost their grade point average (GPA). This demographic data was gathered to facilitate the matching of participants for data analysis.

Table 9

Demographic Data of Participants

Category	Frequency	Percentage
Gender		
Male	123	45.4
Female	148	54.6
Grade		
11th	67	24.7
12th	204	75.3
Course Enrollment		
Calculus AB	164	60.5
Calculus BC	57	21.0
Statistics	44	16.2
Calculus AB and Calculus BC	4	1.5
Calculus AB and Statistics	2	0.7
Ethnicity		
African American	4	1.5
Asian	161	59.4
Caucasian, Not of Hispanic Origin	34	12.5
Filipino	8	3.0
Hispanic or Latino	34	12.5
Pacific Islander	1	0.4
Two or More Races	26	9.6
Other	3	1.1
First Semester Grade in Course		
A	112	41.3
B	89	32.8
C	57	21.0
D	9	3.3
F	4	1.5

(continued)

Category	Frequency	Percentage
Reasons for Enrollment in the Course		
I desired to take this course.	128	47.2
It was the only math course option available to me.	28	10.3
My parents forced me to enroll.	11	4.1
My counselor forced me to enroll.	6	2.2
I wanted the GPA boost.	66	24.4
I wanted to boost my college application with the AP designation.	111	41.0
I wanted to challenge myself.	118	43.5
I really like mathematics.	60	22.1
Other	22	8.1
Total	271	100.0

In addition to the demographic data collected above, participants were also asked to acknowledge what services, if any, they were provided by the school district, as seen in Table 10. This survey question was a means to collect information to quantify how many students were previously identified as gifted and talented. Some students received multiple services by the school district and acknowledged that by checking numerous boxes on the survey. Of the 271 useable student responses, 112 students (41.3%) declared they were previously identified as GT, with 19 of those students also receiving free or reduced lunch, four also received services as English language learners, and one student also received both free and reduced lunch and English language learner services. One hundred and fifty-nine student participants were not previously identified as GT. Of this non-identified GT population, three students received services as an English language learner, 39 students received free and reduced lunch, one student received behavioral services via special education, and two students received services for both English language learner and free and reduced lunch. As referenced in Chapter 3, a minimum

sample size of 180 students, with 50% of the students being previously identified as GT, was necessary for the analytic method of MANOVA that was planned. With a sample of 271 students with 112 of those students previously identified as GT and 159 non-identified GT , the minimum requirements for MANOVA were met. The additional services received that students identified were used in the matching process.

Table 10

Services Provided by the School District

Category	Frequency	Percentage
Services Provided by the School District		
Identification as Gifted and Talented (GATE)	88	32.5
Identification as Gifted and Talented (GATE), Free or Reduced Lunch	19	7.0
Identification as Gifted and Talented (GATE), English as a second language or English Language Learner	4	1.5
Identification as Gifted and Talented (GATE), English as a second language or English Language Learner, Free or Reduced	1	0.4
English as a second language or English Language Learner	3	1.1
Free or Reduced Lunch	39	14.4
English as a second language or English Language Learner, Free or Reduced Lunch	2	0.7
Special Education - Behavioral services	1	0.4
None of the above	114	42.1
Total	271	100.0

Matched demographic characteristics of the population. As part of the data analysis, each GT student was matched with a non-GT student based on their responses on the

demographic questionnaire. The matching process eliminated 47 non-GT students from the data set and used the perception results for all 112 GT students. Students were matched by gender, grade level, class of enrollment, grade in the course for the first semester, ethnicity, other services received from the school, and finally, by the school of enrollment. Through the matching of characteristics, the population for data analysis was reduced to 224 students, with 112 previously identified as GT and 112 identified as non-GT.

The matched data set included 102 males (45.5%) and 122 females (54.5%). As displayed in Table 11, a majority of these students were in 12th grade (*n* = 160, 71.4%), with the remaining 64 students (28.6%) enrolled in 11th grade. Of the 224 students in the matched data set, 139 (62.1%) were enrolled in Calculus AB, 53 (23.7%) were enrolled in Calculus BC, 30 (13.4%) were enrolled in Statistics, and 2 (0.9%) students reported enrollment in both Calculus AB and Calculus BC. The students primarily received passing grades for first semester with 49.1% (*n* = 110) students receiving an A, 33.5% (*n* = 75) receiving a B, 14.3% (*n* = 30) receiving a C, and the remaining 3.1% (*n* = 7) students receiving a D or F grade for the semester. Primarily students identified themselves as Asian (*n* = 138, 61.6%), with the remaining students identifying as Caucasian, not of Hispanic Origin (*n* = 31, 13.8%), Two or More Races (*n* = 23, 10.6%), Hispanic (*n* = 20, 8.9%), Filipino (*n* = 8, 3.6%), African American (*n* = 2, 0.9%), and two students (0.9%) identifying as Other. Eighty-eight students (39.3%) listed themselves as receiving services for GT, with an additional 19 (8.5%) also receiving free and reduced lunch and four (1.8%) more students also receiving services for English as a second language. Most students used in the data analysis were enrolled at XHS (*n* = 140, 62.5%), with the remaining 84 students at ZHS (*n* = 56, 25.0%) and YHS (*n* = 28, 12.5%).

Table 11

Matched Demographic Characteristics of the Population

Category	Frequency	Percentage
Gender		
Male	102	45.5
Female	122	54.5
Grade		
11th	64	28.6
12th	160	71.4
Course Enrollment		
Calculus AB	139	62.1
Calculus BC	53	23.7
Statistics	30	13.4
Calculus AB and Calculus BC	2	0.9
First Semester Grade in Course		
A	110	49.1
B	75	33.5
C	32	14.3
D	3	1.3
F	4	1.8
Ethnicity		
African American	2	0.9
Asian	138	61.6
Caucasian, Not of Hispanic Origin	31	13.8
Filipino	8	3.6
Hispanic or Latino	20	8.9
Two or More Races	23	10.6
Other	2	0.9
Services Provided by the School District		
Identification as Gifted and Talented (GATE)	88	39.3
Identification as Gifted and Talented (GATE), Free or Reduced Lunch	19	8.5

(continued)

Category	Frequency	Percentage
Services Provided by the School District		
Identification as Gifted and Talented (GATE), English as a second language or English Language Learner	4	1.8
English as a second language or English Language Learner	3	1.3
Free or Reduced Lunch	24	10.7
None of the above	82	36.6
Other	4	1.8
School of Enrollment		
X High School	140	62.5
Y High School	28	12.5
Z High School	56	25.0
Total	224	100.0

Data Preparation

The data of interest was gathered using a Qualtrics survey, which contained 24 Likert scaled questions and nine demographic questions. For each of the 24-questions, students were asked to respond to questions by selecting a response from the following: strongly disagree, disagree, undecided, agree, and strongly agree. Qualtrics coded each student's response for each question from one to five, with *strongly disagree* as a one and *strongly agree* as a five. The data was downloaded into an Excel document where all identifying student information was removed, as were the eight rejected responses. In Excel, descriptive statistics for mean, median, and standard deviation were calculated for all valid responses and each of the two groups of interest. The higher arithmetic means score would indicate a stronger perceived agreement with the provided statements on appeal, challenge, or learning choice. After Excel calculations, the data was exported as a comma-separated file for analysis using RStudio's 'psych' package. The descriptive statistics were also vacuumed in RStudio.

RStudio was used to match each of the 112 GT students with another non-GT student. RStudio calculated the overall arithmetic mean score and the median score for each of the three variables using the numerically coded student responses for each of the seven questions for each variable. The descriptive statistics identified a left-skewness in the data, as shown in the histograms for each variable in Figure 7. The data was transformed logarithmically to make it more symmetric and have less variability for data analysis, as shown in Figure 8. The Q-Q plots in Figure 9, which were created after the transformation of data, showed roughly a straight line illustrating that the data was now normally distributed. Likewise, after the transformation of data, the p-values obtained using the Shapiro-Wilk's normality test were all near or above 0.05 with choice at 0.087, challenge at 0.043, and appeal at 0.035 providing further evidence that the transformed data was now normally distributed. Although two values were below the 0.05 threshold, they were reasonably close. Thus, the Q-Q plot showed a reasonable fit. After data transformation, the RStudio 'psych' package was used for statistical analysis. The reported characteristics of distribution, as shown in Table 12, confirmed that all statistical assumptions were met for each of the variables of appeal, challenge, and learning choice. Therefore, the assumptions of normality and heterogeneity were all deemed satisfied after the logarithmic transformation of the data in RStudio.

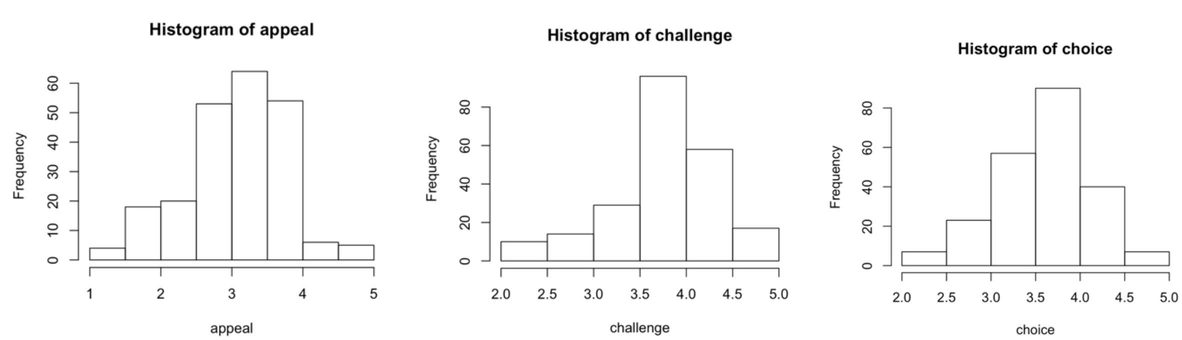


Figure 7: Histograms showing Left Skewness of Matched Data

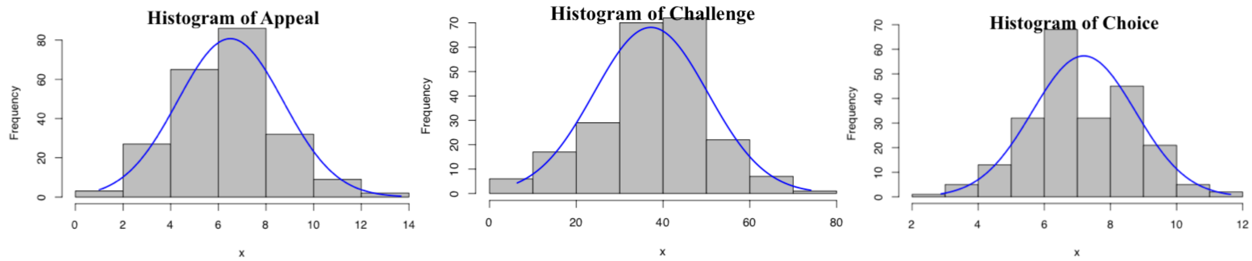


Figure 8: Histograms after Logarithmic Transformation of Data

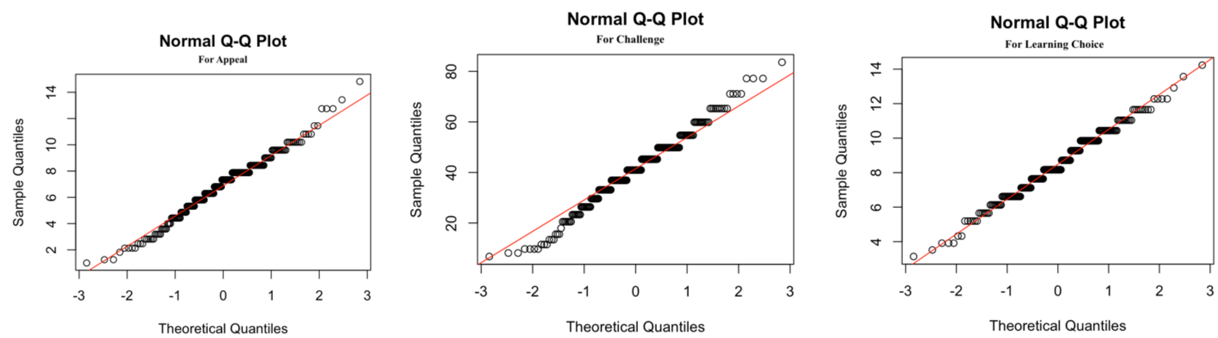


Figure 9: Q-Q Plots of Transformed Data

Table 12

Characteristics of Distribution for Appeal, Challenge, and Choice

	Appeal Value	**Appeal p-value**	**Challenge Value**	**Challenge p-value**	**Choice Value**	**Choice p-value**
Global Stat	1.039e+00	0.904	1.736e-01	0.996	8.921e-01	0.926
Skewness	4.302e-02	0.836	3.885e-02	0.844	7.885e-02	0.779
Kurtosis	5.177e-01	0.472	2.651e-02	0.871	6.040e-05	0.994
Link Function	-5.640e-16	1.000	-6.952e-16	1.000	-4.918e-15	1.000
Heteroscedasticity	4.785e-01	0.489	1.083e-01	0.742	8.132e-01	0.367

Instrument Reliability

The reliability of the SPOCQ instrument used in this study was corroborated through previous studies, as indicated in Chapter 3. The SPOCQ was built on an earlier instrument, My Class Activities, that was piloted and then refined (Gentry & Owen, 2004). Gentry and Owen

(2004) used SPSS version 12 to generate descriptive statistics and alpha reliability coefficients for the refined instrument, the SPOCQ, to confirm reliability. The alpha estimates for each variable of concern in this study were as follows when confirmed by Gentry and Owen (2004): choice (.81), appeal (.85), and challenge (.81). The alpha reliability results obtained using RStudio for the matched data set in this research were 0.660 for choice, 0.810 for appeal, and 0.730 for challenge. These outputs suggest that the survey may not have been entirely reliable for the current population regarding the variable of choice due to the Cronbach's alpha level of 0.66, which does not meet the acceptably reliable value of 0.700 or higher (Urdan, 2017). Gentry and Owen's (2004) confirmatory factor analysis (CFA) results produced a Bentler's Comparative Fit Index (CFI) of 0.997, which represented a good model fit to the data. The factor analysis that was run by Gentry and Owen found a root mean square error of approximation (RMSEA) or 0.051, thus suggesting a reasonable fit of the data. RStudio calculations found a root mean square of residuals of 0.050, suggesting that the model is a good fit to the data. Therefore, the questions on appeal, learning choice, and challenge used in this research are considered mostly reliable, with choice's Cronbach's alpha level near the reasonably reliable level.

Analytic Techniques

For data analysis, the researcher inputted the data gathered from the Qualtrics survey into Excel and then utilized RStudio statistical software. The descriptive statistics of mean, median, standard deviation were all calculated according to the three variables of appeal, challenge, and choice. The statistics were first calculated in Excel prior to matching for the entire population, the GT population, and the non-identified GT population. RStudio was then used to match each GT participant with a non-identified GT participant, and then RStudio ran descriptive statistics

for the mean, median, and the minimum and maximum response on the Likert Scale. The primary data analysis technique utilized in this study was MANOVA because the study sought to examine if the two groups of students differed in their perceptions across the three outcome variables (Field, 2013). To validate the hypothesis, it was necessary to find a significance level of 0.050.

Descriptive Statistics of the Study Instrument

Tables 13, 14, and 15 provide a raw analysis of the mean, median and standard deviation prior to transforming the data and matching participants for the variables of appeal, challenge, and learning choice. The means for the entire population for appeal, challenge, and learning choice were 3.010, 3.776, and 3.616 respectively, with the standard deviations of 1.095, 0.929, and 0.957, correspondingly. Therefore, the responses for those who took the survey for each variable had a mean response between undecided and agree, with the appeal mean being closest to the response of undecided and the mean for challenge being closest to the agree response. All variables for the entire population had a median value of four, indicating a median response of agree on the survey. Gifted and Talented students' statistical data showed means of 3.029 for appeal, 3.713 for challenge, and 3.526 for learning choice, with the respective standard deviations for 1.142, 0.958, and 1.018, as evidenced in Table 14. These responses were similar to the overall population responses in that appeal had the lowest mean, and challenge the highest. The median response for appeal was a three for undecided, while the median response of four for challenge and learning choice matched with the agree response. The mean values for the non-identified GT were 3.149 for appeal, 3.820 for challenge, and 3.672 for learning choice, and had the respective standard deviations of 0.908, 0.907, 0.908. Similar to the entire population samples, the appeal value was the lowest and closest to the undecided response, and challenge

had the highest mean with a response correlating with the agree statement. The mean values for each of the three variables of appeal, challenge, and learning choice were higher for the non-identified GT students in comparison the gifted and talented students. In both populations the median response for appeal was a three of undecided, while the median for challenge and learning choice was a four correlating with the response of agree.

Table 13

Entire Population Descriptive Statistics Prior to Matching

Variable	No. of items	Mean	Median	Standard Deviation
Appeal	7	3.010	4	1.095
Challenge	7	3.776	4	0.929
Learning Choice	7	3.616	4	0.957

Table 14

Gifted and Talented Descriptive Statistics Prior to Matching

Variable	No. of items	Mean	Median	Standard Deviation
Appeal	7	3.029	3	1.142
Challenge	7	3.713	4	0.958
Learning Choice	7	3.536	4	1.018

Table 15

Non-Identified Gifted and Talented Descriptive Statistics Prior to Matching

Variable	No. of items	Mean	Median	Standard Deviation
Appeal	7	3.149	3	0.908
Challenge	7	3.820	4	0.907
Learning Choice	7	3.672	4	0.908

After matching, RStudio ran descriptive statistics for the current overall matched population encompassing both populations of GT and non-identified GT, which are shown in Table 16. The mean response for the current population for appeal was 3.117 with a median of three associating with the response of undecided on the Likert Scale. The minimum response on the Likert scale for appeal was a one for strongly disagree, while the maximum response was a five for strongly agree. Participants responded to challenge with the highest mean of 3.798 and a median response of four correlating with the Likert Scale response of agree. Unlike with the appeal responses, the minimum response was a two for disagree, but the maximum response was strongly agree as observed with the five response, which was similar to appeal. The responses for the current population for learning choice were similar to challenge, with a mean of 3.628, a median of four, a minimum of two, and a maximum of five when compared to the Likert responses.

Table 16

Entire Population Descriptive Statistics After Matching

Variable	No. of items	Mean	Median	Minimum	Maximum
Appeal	7	3.117	3	1	5
Challenge	7	3.798	4	2	5
Learning Choice	7	3.628	4	2	5

The SPOCQ instrument was developed to access student perception using a 5-point Likert scale. For this study, the focus was on the differences in perceptions for students previously identified as GT versus their non-identified GT peers in AP mathematics classrooms. For each of the 21 items, respondents were given five options to choose from: *strongly disagree*,

disagree, *undecided*, *agree*, and *strongly agree*. These responses were then assigned a value from one to five. Of the 21 items from the SPOCQ instrument, seven questions were related to appeal, seven questions were related to challenge, and seven questions were related to learning choice.

Appeal. The mean scores for appeal were calculated using the participants' responses to items 2, 7, 14, 15, 17, 18, and 20 on the second page of the Qualtrics survey (see Appendix D). Prior to matching and in Excel, the Likert responses for these questions were summed up and divided by the number of total responses for the specific population of interest to find the mean appeal score for the overall population, GT population, and non-identified GT population, as shown in Table 17. The GT population had the lowest mean, in comparison with the non-identified GT and overall population means, for the appeal variable and the highest standard deviation meaning that the responses were more spread out from the mean for this group. The mean scores for all populations were closest to the response of undecided for course appeal.

Table 17

Appeal Descriptive Statistics

	Strongly Disagree (1)		Disagree (2)		Undecided (3)		Agree (4)		Strongly Agree (5)		**Appeal** Mean	SD
Population	n	%	n	%	n	%	n	%	n	%		
Overall	162	8.5	443	23.4	458	24.1	712	37.5	122	6.4	3.100	1.095
Gifted and Talented	87	11.1	190	24.2	168	21.4	291	37.1	48	6.1	3.029	1.142
Non-Identified	75	6.7	253	22.7	290	26.1	421	37.8	74	6.6	3.149	1.058

Challenge. The mean scores for challenge were calculated using the participants' responses to items 3, 6, 8, 10, 12, 19, and 21 on the second page of the Qualtrics survey (see Appendix D). Prior to matching and in Excel, the Likert responses for these questions were summed up and divided by the number of total responses for the specific population of interest to find the mean appeal score for the overall population, GT population, and non-identified GT population, as shown in Table 18. The GT population had the lowest mean, in comparison with the non-identified GT and overall population means, for the learning choice variable and the highest standard deviation meaning that the responses were more spread out from the mean for this group. Each population's mean value was closest to the agree response on the Likert scale in response to the AP math course challenging the student.

Table 18

Descriptive Statistics for Challenge

	Strongly Disagree (1)		Disagree (2)		Undecided (3)		Agree (4)		Strongly Agree (5)		**Challenge** Mean	SD
Population	n	%	n	%	n	%	n	%	n	%		
Overall	44	2.3	184	9.7	263	13.9	1068	56.3	338	17.8	3.776	0.929
Gifted and Talented	18	2.3	96	12.2	108	13.8	433	55.2	129	16.5	3.713	0.958
Non-Identified	26	2.3	88	7.9	155	13.9	635	57.1	209	18.8	3.820	0.907

Learning choice. The mean scores for learning choice were calculated using the participants' responses to items 1, 4, 5, 9, 11, 12, and 16 on the second page of the Qualtrics survey (see Appendix D). Prior to matching and in Excel, the Likert responses for these questions were summed up and divided by the number of total responses for the specific

population of interest to find the mean appeal score for the overall population, GT population, and non-identified GT population, as shown in Table 19. The GT population had the lowest mean, in comparison with the non-identified GT and overall population means, for the learning choice variable and the highest standard deviation meaning that the responses were more spread out from the mean for this group. The responses for each population group were between the undecided and agree response for the AP math courses offering of learning choice.

Table 19

Learning Choice Descriptive Statistics

	Strongly Disagree (1)		Disagree (2)		Undecided (3)		Agree (4)		Strongly Agree (5)		**Learning Choice** Mean	SD
Population	n	%	n	%	n	%	n	%	n	%		
Overall	38	2.0	262	13.8	359	18.9	970	51.1	268	14.1	3.616	0.957
Gifted and Talented	25	3.2	127	16.2	141	18.0	385	49.1	106	13.5	3.536	1.018
Non-Identified	13	1.2	135	12.1	218	19.6	585	52.6	162	14.6	3.672	0.908

Course Pace and Intervention Period

The mean scores for the additional three questions added to the Student Perceptions of Classroom Quality questions were calculated using the participants' responses to items 22, 23, and 24 on the second page of the Qualtrics survey (see Appendix D). Prior to matching and in Excel, the Likert responses for each of these questions were summed up and divided by the number of total responses for the specific population of interest to find the mean score response for the overall population, GT population, and non-identified GT population. Table 20 represents the responses to question 22 in reference to the pace of the course being just right for

me. The GT population recorded the highest mean, 3.295, and standard deviation, 1.086, in response to this question. Each mean score in Table 20 represents a response closest to the undecided answer on the survey about the course having an adequate pace for the student.

Table 20

Descriptive Statistics for Course Pace

	Strongly Disagree (1)		Disagree (2)		Undecided (3)		Agree (4)		Strongly Agree (5)		**Pace** Mean	SD
Population	n	%	n	%	n	%	n	%	n	%		
Overall	12	4.4	69	25.5	49	18.1	114	42.1	27	10.0	3.277	1.086
Gifted and Talented	6	5.4	31	27.7	11	9.8	52	46.4	12	10.7	3.295	1.144
Non-Identified	6	3.8	38	23.9	38	23.9	62	39.0	15	9.4	3.264	1.046

Questions 23 and 24 sought feedback on the Response to Intervention model and its effectiveness for GT students in terms of enrichment and support to be successful in the AP course. These questions were optional on the survey because not all schools participating in the study had an RtI intervention period. Table 21 represents the responses to question 23 in reference to the intervention enriching the curriculum of the course. The non-identified GT students had the highest mean response, 3.62, and standard deviation, 1.121, in response to the intervention period enriching the curriculum. For each population group, the mean Likert scale reply was between undecided and agree for the statement concerning enrichment. The mean response values for Table 22 represent the responses to question 24 in indication to the intervention period providing support for the student to be successful in the course. The mean and standard deviations for intervention supporting the course was highest for GT population at

3.962 and GT population also had the lowest standard deviation for this question at 1.004. In examination of the means for each population, the mean reaction to the intervention period supporting the coursework was closest to the agree statement on the Likert scale.

Table 21

Descriptive Statistics for Intervention Enriching the AP Course

	Strongly Disagree (1)		Disagree (2)		Undecided (3)		Agree (4)		Strongly Agree (5)		Enriching Mean	SD
Population	n	%	n	%	n	%	n	%	n	%		
Overall	11	4.3	36	14.2	51	20.1	103	40.6	53	20.9	3.594	1.098
Gifted and Talented	3	2.9	17	16.3	23	22.1	41	39.4	20	19.2	3.558	1.069
Non-Identified	8	5.3	19	12.7	28	18.7	62	41.3	33	22.0	3.620	1.121

Table 22

Descriptive Statistics for Intervention Supporting the AP Course

	Strongly Disagree (1)		Disagree (2)		Undecided (3)		Agree (4)		Strongly Agree (5)		**Supporting** Mean	SD
Population	n	%	n	%	n	%	n	%	n	%		
Overall	9	3.6	18	7.1	32	12.6	114	45.1	80	31.6	3.941	1.024
Gifted and Talented	3	2.9	7	6.7	15	14.4	45	43.3	34	32.7	3.962	1.004
Non-Identified	6	4.0	11	7.4	17	11.4	69	46.3	46	30.9	3.926	1.010

Null Hypothesis Significance Test of the Multivariate Analysis of Variance

The research study sought to answer the research question by testing the null hypothesis that there was no statistically significant difference in perceptions of appeal, challenge and learning choice in high school AP mathematics courses between AP students who were previously identified as gifted and talented versus those who were not. Using RStudio, student response data was matched and then run through the MANOVA model. The data was found to not be statistically significant ($f = 2.524$, df = 1, $p = 0.059$). as shown in Table 23. With 3 degrees of freedom in the numerator and 20 degrees of freedom in the denominator, the critical value of *F* was 3.10, as calculated using Urdan's (2017) appendix C table on critical values of the *F* distributions. The observed value of *F* was 2.524, thus the observed value of *F* was less than the critical value of *F* deeming the results not statistically significant. Therefore, the null hypothesis was not rejected. The effect size represented by r^2 in Table 23 represents that 2.1% of the variance in responses for the variables can be attributed to the group variable. Although, there was not an inferentially discernable difference in the data using the MANOVA test, there was still a difference in their mean responses.

Table 23

MANOVA Output from RStudio

Df	Pillai's Trace	approx. F	num Df	den Df	Pr(>F)	r^2
1	0.033	2.524	3	20	0.059	0.021

RStudio also ran separate ANOVA tests for each of the three variables. The output values are below in Table 24. Although the omnibus test is not statistically significant, the *p*

values for learning choice (*p* = 0.010) and challenge (*p* = 0.028) show that the data is statistically significant. The *p*-value of 0.079 for appeal is not statistically significant.

Table 24

ANOVA Results for Appeal, Challenge, and Learning Choice

	Degrees of freedom	Sum of Squares	Mean Square	F value	*p* value	Adjusted r^2
Appeal	1	15.08	15.0772	3.105	0.079	0.009
Challenge	1	822	822.32	4.863	0.028	0.017
Learning Choice	1	15.97	15.966	6.7282	0.010	0.025

Summary of Findings

This quantitative study explored the perceptions of previously identified gifted and talented students and their non-identified GT peers in Advanced Placement mathematics courses at three high schools in one Southern California school district. Participants in the study were enrolled in one of three AP high school math classes: Calculus AB, Calculus BC, or Statistics. Data was collected via a survey on Qualtrics including 21 questions from the Student Perceptions of Classroom Quality (SPOCQ) instrument (see Appendix A), created by Gentry and Owen (2004), one question on the pace of the course, two questions on the Response to Invention Tier 2 interventions on the campus, and nine demographic questions. The 271 useable responses were analyzed and matched to run a MANOVA test to address the research hypothesis.

The results of the MANOVA analysis showed no statistically significant differences in the perceptions of those previously identified as gifted and talented versus their non-identified

GT peers. Consequently, there was not enough information to reject the null hypothesis. The mean scores for the two populations did differ, but not to a statistically discernable extent.

The next chapter includes a discussion and synthesize of the findings in correlation with the research outlined in chapter two. There are recommendations for policy and practice in relation to the education of gifted and talented students in Advanced Placement mathematics courses. In addition, some ideas for future research regarding gifted and talented students are suggested.

Chapter 5: Discussion

Introduction

Chapter 4 presented the data and its analysis. Chapter 5 presents a summary of the study, discussion of the findings, implications for policy and practice, recommendations for future studies, and conclusions of the research. The purpose of these sections was to expand upon the concepts reviewed in chapters one and two regarding successfully educating gifted and talented students, in tandem with the implications from the data analysis.

Summary of the Study

The founding documents of the United States of America: *The Declaration of Independence*, *The Constitution*, and the *Bill of Rights*, declared that all men were created equal. Thus, the idea of equity has predominated the culture of the United States leading to wars, the suffrage movement, numerous marches on the capital, Amendments to the Constitution, court cases, and boycotts. A pervasive desire to be treated as equals has imbued the United States since inception. On the education front, equity has been described as using the knowledge of each child’s needs, strengths, and interests to stimulate their minds and open up the possibilities for future inventions, dreams, ideas, and theories (Rockefeller Brothers Fund, 1961). The courts and the streets of the national capital and local capitals have been witness to many citizens arguing for educational equity for those not old enough to vote. To accomplish this monumental task of educational equity, education must embody the ideals of equal access, participation, and outcomes for each and every student in the United States (Brookover & Lezotte, 1981). This statement is true for students with disabilities, homeless students, foster students, low income students, students of all races, ethnicities, financial backgrounds, or demographic location, as well as students identified as gifted and talented.

The intention of this research study was to examine the concept of educational equity for students previously identified as gifted and talented within Advanced Placement mathematics courses. The AP program was initially designed to provide opportunities for accelerated students to not see a duplication of content during their junior and senior years of high school, and the first years of college (Arbolino, 1961, 1964; Colangelo et al., 2004; Freedman & Frugman, 2001; Hertberg-Davis, Callahan, & Kyburg, 2006; Rehm, 2014; Rothschild, 1999). Initial AP exam takers were an elite small group of exceptional high school students, but that group has transformed over the years in response to educational publications and movements, such as *A Nation at Risk*, No Child Left Behind, and Every Student Succeeds Act (Arbolino, 1961, 1964; Colangelo, Assouline, Gross, & Iowa University, 2004; Freedman & Krugman, 2001; Johnston & Viadero, 2000; Kraeger, 2015; Loveless et al., 2008; Norris, 2013; Rehm, 2014; Rothschild, 1999; Russo, 2001; VanTassel-Baska, 2018). Hence, the population of students in AP classrooms has transformed since inception, and the focus of education has shifted towards closing the achievement gap, not academic excellence, and teachers are less prepared to address the differentiation and acceleration needs of gifted and talented students (Hertberg-Davis, Callahan, & Kyburg, 2006; Loveless et al., 2008; Seedorf, 2011; VanTassel-Baska & Stambaugh, 2005).

For these reasons, this quantitative, comparative, quasi-experimental study sought to seek out what differences, if any, existed in the perceived appeal, challenge, and learning choice in high school Advanced Placement (AP) mathematics courses between AP students who were previously identified as GT versus a matched group of those who were not. The gifted and talented population of students was chosen to study because of the shift in diversity of the AP student population, as a result of open assess requirements, from the time of the first AP exams

in 1956 where most students were of exceptional ability to the current heterogenous population of students with many different levels of skill (Mollison, 2006). A survey was given in May 2019 after the AP exam to students currently enrolled in either AP Calculus AB, AP Calculus BC, or AP Statistics. The analysis sought to investigate if any differences in perceptions of appeal, challenge, and learning choice existed between the two populations of students in these accelerated, college-level courses, which are offered to all students.

This research study tried to fill the gap in the literature about GT students by comparing the perspectives of previously identified GT students and their non-identified GT peers in AP mathematics programs in relation to the variables of appeal, challenge, and choice. Previous studies focused on teachers' perceptions, differentiation for GT, the AP program, and the benefits of the AP program for GT (Abu Hassoun, 2015; Ayebo, 2010; Clark, Moore, & Slate; 2012; Daugherty, 2010; Geddes, 2010; Hertberg-Davis, Callahan, & Kyburg, 2006; Hertberg-Davis, & Callahan, 2008; Kern 2012; Marotta-Garcia, 2011; Norris, 2013; Palladino, 2008, Poli, 2018; Reilly, 2014; Rothschild, 1999). This research study provided information and data relevant to all educators working with populations of GT students and a reminder to focus not just on closing the achievement gap, but also working with GT students who may not be equitably educated in a way that meets their exceptional needs, especially in classrooms where the Response to Intervention model of three tiers of support occur. The tiers of support require that teacher differentiate for all students at the tier one level to meet students at their level of learning and push them beyond. At both the tier one and two levels, this may require further enrichment or advancement curriculum for GT students.

The application of the theoretical framework of educational equity for this study was embodied in the collection of student feedback, from both those previously identified as GT and

their non-identified GT peers, in relation to their perceptions of their AP mathematics courses. The ultimate purpose of the study was to examine the perceptions of students to determine if these AP mathematics courses were meeting their educational needs in regards to the three standards of equity: access, participation, and outcomes (Brookover & Lezotte, 1981). All students have access to the courses as part of the open-enrollment policy, but not every class may allow for equal participation in learning experiences or allow for an equal outcome where all students perform at their own personal highest level of accomplishment (Bish, 1958; Brookover & Lezotte, 1981; Davidson et al., 2004).

Research question and hypothesis. To accomplish the purpose of this study in regards to participation and outcomes, the guiding research question was: To what extent, if at all, do differences exist in perceptions of appeal, challenge and learning choice in high school AP mathematics courses between AP students who were previously identified as gifted and talented versus a matched group of those who were not? It was hypothesized that the AP mathematics classes did not provide sufficient experiences for GT students who needed to be challenged, find interest in the learning, and be provided with multiple avenues of process and expression. Without these experiences, educational equity would not occur at the participation and outcomes level. The null hypothesis that was tested in this research study was that there was no significant differences in perceptions of appeal, challenge and learning choice in high school AP mathematics courses between AP students who were previously identified as gifted and talented versus those who were not.

Methodology. To answer the research question, a Qualtrics survey was administered with 21 questions from the Student Perceptions of Classroom Quality (SPOCQ) instrument created by Gentry and Owen (2004; See Appendices A and D). Three additional questions were

added to the survey with one about the pace of the course and the other two about the students' perceptions about the Response to Intervention Tier 2 interventions held at their school sites for these AP courses. For each of these 24 questions, students responded on a Likert scale from one to five, with one correlating with the response *Strongly Disagree* and five correlating with the response *Strongly Agree*. In addition, the survey collected demographic data on participants to identify students previously identified as gifted and talented, as well as to assist in the matching of students prior to conducting a multivariate analysis of variance. The MANOVA was performed to compare the mean responses of students previously identified as GT and a matched group of non-identified GT peers on the variables of appeal, challenge, and learning choice.

Participants. The study included responses from 271 Advanced Placement mathematics students from three high schools in one Southern California school district. Of the participants, 112 students identified as gifted and talented and 159 students were not previously identified as gifted and talented. To match the 112 GT students for the MANOVA test, RStudio used the demographics of gender (123 Male , 148 Female), enrolled grade (67 11^{th} graders, 204 12^{th} graders), course enrollment (164 Calculus AB, 57 Calculus BC, 44 Statistics, 2 Calculus AB and Statistics, 4 Calculus AB and Calculus BC), ethnicity (4 African American, 161 Asian, 34 Caucasian, 8 Filipino, 34 Hispanic or Latino, 1 Pacific Islander, 26 two or more races, 3 other), first semester grade (112 A's, 89 B's, 57 C's, 9 D's, 4 F's), and the additional services they received (i.e. Free or Reduced Lunch, English Language Learner, Special Education).

Discussion of the Findings

Previous researchers, Clark, Moore, and Slate (2012) found no data to show if previously identified GT students benefited more or less than non-identified GT peers in AP courses. Hertberg-Davis and Callahan (2008) found that GT students felt challenged in AP courses, but

were not allowed choice. The goal of this study was to identify if the AP mathematics classes originally designed in 1956 for a homogenous elite population of students were now meeting the needs of the heterogenous population of students who are enrolled in AP classes 63 years later. To meet this goal, the survey administered to students collected data about students' mathematics course experiences through their perceptions of the variables of appeal, challenge, and learning choice.

Raw survey results were analyzed in Excel and after matching the results were analyzed in RStudio. Students were matched in RStudio so that for every response from a GT student, a similar non-identified GT student's response was analyzed in the MANOVA test. The raw data from Excel was also used to compare all student responses.

Descriptive statistics results. Prior to matching and in Excel, GT students' mean values in relation to the variables of appeal, challenge and learning choice were calculated to be 3.029 (SD = 1.142), 3.713 (SD = 0.958), and 3.526 (SD = 1.018), respectively. The non-identified GT mean values for appeal, challenge, and learning choice were 3.149 (SD = 0.908), 3.820 (0.907), and 3.672 (SD = 0.908), correspondingly. For each of the variables, the mean value from non-identified GT participants was higher than the mean for gifted and talented participants. Between both groups of students, the appeal variable received the lowest mean responses, while the challenge variable had the highest mean responses for both the previously identified GT group and non-identified GT group.

Appeal. Appeal was defined as when students found enjoyment in a course, were interested in the material, and engaged in the classroom environment (Gentry & Owen, 2004). Of the 271 students who responded to the survey, only 60 of them stated in the demographic sections that they really like mathematics and 111 students selected that they took the course to

boost their college applications with the AP designation. For a course to appeal to students they must desire to study the topic in depth (Rogers, 2007; Tannenbaum, 1983). Therefore, the lower appeal values may relate to their reasons for taking the course in the first place.

Challenge. Challenge was defined as students experiencing a compilation of depth, complexity, and rigor while learning mathematics (Gentry & Owen, 2004). The high challenge response correlates with the course frameworks for the AP mathematics courses, where students grow their stamina in persevering to solve challenging problems of greater rigor, complexity, and depth (Gentry & Springer, 2002; Gentry & Owen, 2004, Krist, 1999). In these courses, students learn concepts through algebraic process or exploration of data patterns, and eventually connect multiple representation to build fluency or to begin to build fluency (College Board, 2010; College Board, 2016). Students begin on smaller concepts and eventually learn to make connections between concepts, so that they can link them all together on the AP examinations in May. They work all year building their stamina mathematically, which may account for the higher overall response in regards to questions concerning challenge. One hundred eighteen participants stated that they took the particular AP mathematics course to challenge themselves, which the data suggests that most students agreed that they were challenged during the course.

Learning choice. Learning choice was defined as having ownership of individual learning by making decisions about the content, process, and product during the learning experience (Gentry & Owen, 2004). Student responses for both groups hovered between "undecided" and "agree" in relation to learning choice. The school district where this study was conducted had transitioned to a Response to Intervention model which encourages using student data to inform instructional decisions, so there was a possibility that students were able to somewhat make their own decisions in regards to assignments (Brown, 2012). However, given

the AP curriculum structure, there was a high likelihood that content variation was not an option for students.

MANOVA results for perceptions of appeal, challenge, and learning choice. After matching previously identified gifted and talented students with their non-identified GT counterparts in RStudio, the MANOVA test revealed a non-statistically significant difference in perceptions ($f = 2.524$, $df = 1$, $p = 0.059$). The critical value of F was 3.10, but the observed value of F was 2.524, thus the observed value of F was less than the critical value of F deeming the results not statistically significant. Therefore, the evidence failed to reject the null hypothesis. There was a statistically non-significant difference in the perceptions of appeal, challenge, and learning choice between those previously identified as GT and their non-identified GT peer, but a difference in their mean responses was still present.

The lack of statistical significance suggests that there is a possibility of educational equity for students previously identified as gifted and talented and their non-identified GT peers enrolled in AP mathematics courses. The transformation and growth of the Advanced Placement program from 1956 with 1,299 students to the 2018 enrollment of 2,808,990 students may not have had such a detrimental effect on the outcomes for GT students and their perceptions of the courses themselves (College Board, 2018a). There also exists the possibility that the AP program is the great equalizer that promotes equal opportunities for every student to pursue the American Dream (Colangelo et al., 2004). However, Hertberg-Davis and Callahan's (2008) previous research found that students were dropping out of AP classes because they were too rigid and did not allow for learning choice. This study did not include responses for students who were no longer enrolled in the AP mathematics course. Thus, there also remains the possibility that the growth of the program is not benefitting all students equally.

Additional survey question results. The additional questions on the survey, not from the SPOCQ, resulted in different means for both groups of students. GT students recorded a higher mean for the pace being just right for the AP mathematics course in relation to their non-identified GT peers, but only by 0.031. However, based on the mean scores, most students responded with the "undecided" answer regarding pacing. With set dates for AP exams each May, a set curriculum for teachers of AP courses to teach prior to the test date, and fluctuating school start dates, the pace of these courses is on a tight timeline. Gifted and talented students may have had the higher mean value because of the benefit of the acceleration of the course. The AP courses must engage some form of curriculum compacting, which is a form of acceleration (Colangelo et al., 2004).

For the two questions pertaining to the Response to Intervention Tier 2 level interventions, there was also little difference between the responses for each group in relation to the course enriching or supporting their learning. In both groups, the mean responses for the course enriching their learning and supporting their learning leaned toward the response of "*agree*," with supporting their learning having a higher mean score. These findings suggest that AP mathematics teachers may be meeting the needs of both struggling and excelling students during the Tier 2 interventions.

Implications for Policy and Practice

Although the findings reported a statistically non-significant difference in perceptions of appeal, challenge, and learning choice for the two groups, there still existed a difference between the two groups for each variable. Previously identified gifted and talented student mean responses for each variable were lower than the mean responses for their non-identified GT peers. If the educational experiences were completely equitable, it would be expected to see the

mean values be equivalent. Likewise, if the educational experiences were equitable, the regression in test scores for GT students would most likely not be present (Davidson Institute for Talent Development, 2006; Heim, 1998; Loveless et al., 2008). Thus, there is still work to be done to create experiences for gifted and talented students that meet their educational needs.

Based on lack of equality in the mean data values for the two groups, the state of California Department of Education should require that the Local Control Funding Formula include substantial funding for gifted and talented programs in all school districts, through reinstating the GATE program as mandatory and requiring a maintenance of effort for GATE. The funds ought to be used to train teachers and teachers-in-training to work with and differentiate curriculum for GT students because it is known that with three to five graduate level courses in teaching the GT students, teachers are more effective in creating enriching experiences for GT students (Davidson et al., 2004). If sufficient learning is not happening in credentialing programs, then the schools have the liability of preparing teachers. By linking a monetary value to the GT population, GT students may once again become a required tracked demographic group in which their student achievement data would be disaggregated just like students with disabilities, low income students, and English language learners (Hodges et al., 2018; Loveless et al., 2008; Siemer, 2009). This tracking of data would encourage teachers to support not just the struggling students, but all students in regards to creating courses that appeal to students, challenge them to learn deeply, and providing them choice in learning opportunities.

Within practice in the classrooms, teachers still need to be able to create and design curriculum and instruction such that it appeals to GT students, challenges these students to think at a deeper level, and provides possible choices within the curriculum. The differences in the mean scores between the groups show that GT students are not necessarily finding the same level

of appeal, challenge and choice in their AP mathematics classes, as their non-identified GT peers. The fact that both groups mean scores hover between the responses of "*undecided*" and "*agree*", without reaching the "*strongly agree*" response implies that teachers of AP mathematics classes need to acknowledge that instruction and curriculum for these courses needs to be revisited and possibly revised. Likewise, the College Board needs to take notice that the prescribed frameworks they have developed are not fully meeting the needs of their students in terms of appeal, challenge, and learning choice. Advanced Placement programs do allow for the idea of acceleration for GT students, but they also need to support the concept of differentiation to meet the gifted and talented students' individual learning needs.

Along with differentiation within the regularly daily class meetings, the findings from this study suggest that there is still work to be done for all students at the Response to Intervention Tier 2 level. Participants responded that the intervention periods supported their learning at a close to "*agree*" level, but responses were not as high between both groups in the response to enriching the curriculum. In practice, teachers need to be more aware of the intervention periods they are planning for students in AP mathematics courses so that the intervention enriches the learning of the mathematics material. As suggested by Buffman, Mattos, and Weber (2102), Tier 2 interventions may include activities that extend the learning for advanced students, but if there is a focus on closing the achievement gap, these extensions may not be occurring. Teachers and administrators need to make it a practice to include enrichment activities as part of the Tier 2 interventions to support AP students, especially GT students.

Recommendations for Further Research

While the difference in perceptions between students previously identified as gifted and talented and their non-identified GT peers was not inferentially discernable, given the difference in their mean responses, there is more research to be explored regarding the use of differentiation and acceleration strategies targeted for GT students in Advanced Placement classrooms and possibly research very similar to this about perceptions between groups of students is recommended. Likewise, if the omnibus test first been statistically significant, the challenge and choice variable outcomes would have been predicted by the two groups of previously identified as GT and non-identified GT. Teachers have said that they focus on the struggling learners in their classrooms, and it is known that GT learners regress in their test scores, so more research needs to be done to investigate what is occurring in these AP classrooms so that the needs of GT students are met in this de facto curriculum (Davidson Institute for Talent Development, 2006; Heim, 1998; Loveless et al., 2008). For educational equity to occur, all students must have access to a rigorous curriculum that meets their learning needs, even if some of those students tend to initially perform at a higher level in a lower grade.

Employ a revised version of the survey used in this study, or an alternative measure. The Likert scale in this study only went from one to five. Given such few choices between strongly disagree and strongly agree, many students chose undecided when answering the survey questions. Future researchers may want to take the Likert Scale and extend it from one to ten to assess if a statistically significant result can be obtained using the same survey questions. The literature suggests that GT students are not performing at the same levels year after year, so the question still remains if GT students feel that these Advanced Placement mathematics classes truly appeal to their intellect, provide multiple learning choices throughout the course, and

challenge these students at their level of need (Loveless et al., 2008). The data gathered in this survey with the five-point Likert scale suggests there is a difference in perceptions between the two populations, with the previously identified GT group's mean score lower than their non-identified GT peers, but the limited range of the response options may mask these differences. Changing the Likert scale may give students more of a voice to assess their learning needs and provide better differentiated data. Alternately, researchers may wish to replicate this study, but using an alternative outcome measure, such as the Students' Perceptions of Teaching Quality Rating Scale (Göllner, Wagner, Eccles & Trautwein, 2018), the Supportive Learning Environment for Expertise Development Questionnaire (Elvira, Beausaert, Segers, Imants & Dankbaar, 2016), or the Quality of Life in School Questionnaire (Weintraub & Erez, 2009).

Study the lived experiences of gifted and talented students and their non-identified peers in AP mathematics classrooms. Conducting a phenomenological study where students enrolled AP mathematics classrooms are interviewed to describe their lived experiences and perspectives in terms of appeal, challenge, and learning choice would be a nice balance to the survey questions asked in this study. Given the lack of statistically significant findings in this study, but a variation in the means, collecting qualitative data via interviews of students may provide more thorough evidence of the differentiation and acceleration options available to AP mathematics students in the classroom. Students would be able to provide a voice to the evidence that teachers are focusing their time and differentiation tactics on the struggling students, as was evidenced by teachers in the 2008 Farkas Duffett Research Group study (Loveless et al., 2008). Students would also be able to verbalize their perceptions of appeal, challenge and learning choice and explain their ratings more thoroughly.

Study the differentiation practices successful teachers of gifted and talented students use. The data did not show an inferentially discernable variation in the means between the two populations of students. Hence, the AP mathematics teachers of the participants may already be altering the curriculum to meet the needs of students using strategies outlined in Chapter 2. To individualize the curriculum for students, teachers may be adjusting the content, process, and product while also permitting for creativity and engagement in the learning process (Beasley & Beck, 2017; Gentry & Owen, 2004; Kaplan, 2008; Kaplan, McComas & Manzone, 2016; Tredick, 2009). Future researchers may want to conduct an ethnographic or case study where the researcher conducts interviews and observations of teachers of AP mathematics focusing on the differentiation strategies utilized for GT students to find success. These studies could substantiate the case that AP mathematics courses are meeting the needs of GT students because the teachers are differentiating on their own at both the Tier 1 and Tier 2 levels without the assistance of the College Board and its course descriptions and frameworks.

Study in-depth the educational trajectory of a student identified as gifted and talented. It was stated in Chapter 2 that acceleration may be one of the most effective methods for supporting gifted and talented students (Assouline et al., 2015; Heim, 1998; Renzulli, 2000; Rogers, 2007; Siemer, 2009). However, students are not often accelerated for many reasons (Southern & Jones, 2015; Subotnik et al., 2011). Students also need to be challenged to stimulate brain development (Mercola, 2012). Through a longitudinal case or narrative study, a researcher could examine the levels of challenge, differentiation, and acceleration of a student or students who are initially identified as GT in third grade through till their graduation from high school. Collecting data for this extended amount of time would provide a clearer picture from

the perception of the student through interviews and observations, including course selection, about the level of education received by GT students in public schooling.

Study the link between brain plasticity, previous learning environments, and gifted and talented students in AP Mathematics classrooms. With the growth of science, scientists are discovering that the learning environment and the activities that individuals engage in, can enhance or undo giftedness (Webb, 2008). Students may also be impacted years of education lacking challenge or be accustomed to high praise and be unwilling to put themselves in a position where they will fail, thus they have developed a lack of a growth-mindset (Dweck, 2012). The science suggests the possibility that over the years of education GT students have become accustomed to environments that are not appealing, not challenging, or not providing learning choice. Therefore, the brain's plasticity may have decreased and there may no longer be a recognition of AP mathematics courses not meeting their needs. They may have never experienced a classroom that truly meets their individual GT needs and may have not been capable of accurately responding to the survey questions posed in this study, thus the statistically non-significant outcome. Such a research study would provide scientific evidence based in brain research about the connections between neurons and the experiences of classroom environments from kindergarten through to an Advanced Placement mathematics course for GT students.

Conclusion

The Advanced Placement program has undergone many changes since its post Sputnik surge. The number of students enrolled in AP courses has swelled, demographics of participants have diversified, and course curriculums and designs have altered. The homogenous population of gifted and talented students who made up the initial 1,299 students enrolled in the program has morphed into a heterogeneous population of over 2,800,000 students with many learning

needs. The focus in education has shifted towards the struggling learner with the increase in the testing culture of the United States. Schools are using programs such as Response to Intervention to improve student outcomes and differentiate learning for all students. However, teachers are focusing their classroom efforts on struggling learners, so as to close the achievement gap, and the test scores for gifted and talented learners are regressing.

In this quantitative, comparative, quasi-experimental study, a multivariate analysis of variance was used to investigate the perceptions of Advanced Placement mathematics students previously identified as gifted and talented in relation to their matched non-identified GT peers with regard to the concepts of appeal, challenge, and learning choice in Calculus AB, Calculus BC, or Statistics. Data analysis resulted in statistically non-significant differences between the two populations in regards to their perceptions, thus failing to reject the null hypothesis. However, the resulting descriptive statistics showed mean value responses from previously identified gifted and talented students all lower than their non-identified GT peers for each variable. The differences in responses suggest that educational equity of outcomes and participation may not exist in Advanced Placement mathematics classes which include students previously identified as gifted and talented and their non-identified peers. If teachers are going to accommodate for learning, they should accommodate for all.

With these outcomes, it is wished that future researchers will be able to use this existing research as a foundation to further study the perceptions and experiences of gifted and talented students in Advanced Placement mathematics courses. Future research may include a survey of a similar nature, interviews with gifted and talented students, observations and interviews with Advanced Placement mathematics teachers in regard to differentiation and acceleration practices for gifted and talented students, or a look at the relationship between previous learning

environments and giftedness. Notwithstanding, the data gathered here do suggest that there is a need to track the learning outcomes of students identified as gifted and talented and support educators in working with gifted and talented students to create educational programs that appeal to them, challenge them, and provide them choice in their learning.

REFERENCES

A Bill for the More General Diffusion of Knowledge (n.d.). Retrieved from https://www.monticello.org/site/jefferson/bill-more-general-diffusion-knowledge#footnote2_sgzjymm

Abu Hassoun, L. A. (2015). *Good teachers are made and not just born: Gifted and talented teachers' perspectives of effective teaching and teacher needs* (Order No. 3734560). Available from ProQuest Dissertations & Theses Global. (1739017589).

Allain, J. K., & Eberhardt, N. C. (2011). *RtI: The forgotten tier: A practical guide for building a data-driven tier 1 instructional process*. Stockton, KS: Rowe Publishing and Design.

About AP Scores. (n.d.) Retrieved from https://apscore.collegeboard.org/scores/about-ap-scores/

About AP Summer Institutes. (n.d.) Retrieved from https://apcentral.collegeboard.org/professional-development/workshops-summer-institutes/about-summer-institutes

AP Calculus AB Course Overview. (n.d.) Retrieved from https://apstudent.collegeboard.org/apcourse/ap-calculus-ab

AP Opportunity Program. (n.d.) Retrieved from https://apcentral.collegeboard.org/about-ap/start-grow-ap/access-initiatives/ap-opportunity-program

Arbolino, J. (1961). What's wrong with the Advanced Placement program. *NASSP Bulletin, 45,* 1, 28-32

Arbolino, J. (1964). The advanced placement program. *NASSP Bulletin, 48,* 291, 136-141. doi: 10.1177/019263656404829115

Armstrong, T. (2018). Multiple intelligences in the classroom (4th ed.). Alexandria, VA: ASCD.

Assouline, S. G., Colangelo, N., VanTassel-Baska, J., & Lupkowski-Shoplik, A. (2015). A nation empowered: Evidence trumps the excuses holding back America's brightest students. Iowa City, IA: Connie Belin and Jacqueline N. Blank International Center for Gifted Education and Talent Development.

Ayebo, A. (2010). *Teachers' perspectives on teaching mathematics to Gifted/Talented students* (Order No. 3434064). Available from ProQuest Dissertations & Theses Global. (847489452). Retrieved from https://lib.pepperdine.edu/login?url=https://search-proquest-com.lib.pepperdine.edu/docview/847489452?accountid=13159

Baker, B. D. (2001). Gifted children in the current policy and fiscal context of public education: A national snapshot and state-level equity analysis of Texas. *Educational Evaluation and Policy Analysis, 23*(3), 229-250.

Beasley, J. G., & Beck, D. E. (November 01, 2017). Defining differentiation in cyber schools: What online teachers say. *TechTrends: Linking Research and Practice to Improve Learning a Publication of the Association for Educational Communications & Technology, 61,* 6, 550-559.

Bernal, E. M. (2003). To no longer educate the gifted: Programming for gifted students beyond the era of inclusionism. *Gifted Child Quarterly, 47*(3), 183-191.

Bish, C. E. (1958). Can we provide a better program for the able student? *The bulletin of the National Association of Secondary School Principals*, 42, 242, 13-21.

Brackemyre, T. (2015, April 11). Education to the masses: The rise of public education in early America. Retrieved from http://ushistoryscene.com/article/rise-of-public-education/

Brighton, C. M., Hertberg, H. L., Moon, T. R., Tomlinson, C. A., & Callahan, C. M. (2005). *The feasibility of high-end learning in a diverse middle school.* Storrs University of Connecticut, National Research Center on the Gifted and Talented.

Brookover, W. B., & Lezotte, L. (1981). Educational equity: A democratic principle at a crossroads. *The Urban Review: Issues and Ideas in Public Education*, 13, 2, 65-71.

Brown, S. W., Renzuli, J. S., Gubbins, E. J., Siegle, D., Zhang, W., & Chen, C. H. (2005). Assumptions underlying the identification of gifted and talented students. *Gifted Child Quarterly, 49*(1), 68-79.

Brown, E. F. (2012). Is response to intervention and gifted assessment compatible? *Journal of Psychoeducational Assessment, 30*(1), 103-116. doi:10.1177/0734282911428200

Brown v. Board of Educ., 347, U.S. 483 (1954)

Buffum, A., Mattos, M., & Weber, C. (2010). The why behind RTI. *Educational Leadership, 68*(2), 10-16.

Buffum, A., Mattos, M., & Weber, C. (2012). *Simplifying response to intervention: Four essential guiding principles*. Bloomington, IN: Solution Tree.

CAASPP Description – CalEdFacts (2018). Retrieved from https://www.cde.ca.gov/ta/tg/ai/cefcaaspp.asp

California Department of Education (2005). Gifted and talented education program resource guide. Retrieved from https://www.cde.ca.gov/sp/gt/gt/

California Department of Education & the California Association for the Gifted. (1994). *Differentiating the core curriculum and instruction to provide advanced learning opportunities*. Sacramento, CA: California Department of Education.

Callahan, C. M., Moon, T. R., & Oh, S. (2014). *National surveys of gifted programs: Executive Summary*. Charlottesville, VA.

Cardillo, J. (2010). Gifted children: Nurturing genius (part one). Retrieved from https://www.psychologytoday.com/blog/attention-training/201007/gifted-children-nurturing-genius-part-one

Castaneda et al. v. The Regents of the University of California et al., Case No. C99–0525SI (U.S. Dist. Ct., Northern Dist. Ca. 1999).

Chval, K. B., & Davis, J. A. (2009). The gifted student. *Mathematics Teaching in Middle School*, 14(5), 267-274.

Clark, D., Moore, G. W., & Slate, J. R. (2012). The Advanced Placement program and gifted learners: A comparative study of success. *Mercer Journal of Educational Leadership, 1*(1).

Cohoon, S. B. (2015). *State policies in gifted and talented education on acceleration an analysis of state policies and mandates* (Order No. 10002478). Available from ProQuest Dissertations & Theses Global. (1758894784). Retrieved from https://lib.pepperdine.edu/login?url=https://search-proquest-com.lib.pepperdine.edu/docview/1758894784?accountid=13159

Colangelo, N., Assouline, S. G., Gross, M. U. M., & Iowa University, C. B. & J. N. B. I. C. for G. E. and T. D. (2004). *A Nation Deceived: How Schools Hold Back America's Brightest Students. The Templeton National Report on Acceleration. Volume 1*. Connie Belin & Jacqueline N. Blank International Center for Gifted Education and Talent Development. Retrieved from

https://lib.pepperdine.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED535137&login.asp?custid=s8480238&site=ehost-live&scope=site

Coleman, M. R. (1999). Back to the future: The top 10 events that have shaped gifted education in the last century. *Gifted Child Today Magazine*, 22(6), 16–18.

College Board. (2001). *Access to Excellence: A Report of the Commission on the Future of the Advanced Placement Program®. College Board*. College Board. Retrieved from https://lib.pepperdine.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED561056&login.asp?custid=s8480238&site=ehost-live&scope=site

College Board. (2010). Statistics course description. New York, NY: College Board.

College Board. (2012a). Spotlight on success: Strategies for equity and access. Retrieved from https://apcentral.collegeboard.org/pdf/spotlight-success-2012.pdf

College Board. (2012b). Excelerator issue brief: Equity and access in AP. Retrieved from chromeextension://oemmndcbldboiebfnladdacbdfmadadm/http://media.collegeboard.com/digitalServices/pdf/excelerator/AP-Equity-and-Access_IB_June-2012_FINAL.pdf

College Board. (2014). The 10th annual AP report to the nation. Retrieved from https://research.collegeboard.org/programs/ap/data/nation/2014

College Board. (2016). AP Calculus AB and AP Calculus BC: Including the curriculum framework. New York, NY: College Board.

College Board. (2018a). Annual AP program participation 1956-2018. Retrieved from https://research.collegeboard.org/programs/ap/data/participation/ap-2018

College Board. (2018b). AP program participation data and performance data: California state report. Retrieved from https://research.collegeboard.org/programs/ap/data/participation/ap-2018

Colwell, R. (1990). Advanced Placement: More than a test. Music Educators Journal, 76(6), 26. doi: 10.2307/3400965

Cross, T. L. (1999). Top ten list (plus or minus two) for the 20th century. *Gifted Child Today Magazine*, 22(6), 22–25.

Curriculum: GATE identification. (n.d.). Retrieved from https://www.rbusd.org/apps/pages/index.jsp?uREC_ID=853184&type=d&pREC_ID=1219058

Daniel et al. v. The State of California et al., Case No. BC 214156 (Superior Ct., State of California, Los Angeles Superior Ct. 1999).

Davidson, J., Davidson, B., & Vanderkam, L. (2004). Genius denied: How to stop wasting our brightest young minds. New York, NY: Simon & Schuster Paperbacks.

Davidson Institute for Talent Development. (2006). Does no child left behind require that no child can get ahead? Retrieved from http://www.davidsongifted.org/Search-Database/entry/A10361.

Daugherty, M. J. (2010). *Supporting the needs of gifted students: The perspectives, perceptions, and experiences of general education teachers* (Order No. 3412079). Available from ProQuest Dissertations & Theses Global. (725755842).

Dean, C. B., & Marzano, R. J. (2012). *Classroom instruction that works: Research-based strategies for increasing student achievement* (2nd ed.). Alexandria, VA: ASCD.

DuFour, R., DuFour, R., & Eaker, R. (2008). *Revisting professional learning communities at work: New insights for improving schools*. Bloomington, IN: Solution Press.

DuFour, R., DuFour, R., Eaker, R., & Many, T. (2006). *Learning by doing: A handbook for professional learning communities at work*. Bloomington, IN: Solution Tree.

Dweck, C. (2012). *Mindset: How can you fulfil your potential*. London: Robinson.

EdData (2018). Retrieved from: https://www.ed-data.org/

Elvira, Q., Beausaert, S., Segers, M., Imants, J., & Dankbaar, B. (2016). Development and validation of a supportive learning environment for expertise development questionnaire (SLEED-Q). *Learning Environments Research, 19*(1), 17-41. http://dx.doi.org/10.1007/s10984-015-9197-y

Every Student Succeeds Act (ESSA) (n.d.). Retrieved from https://www.ed.gov/essa?src=rn

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39, 175-191.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics and sex and drugs and rock 'n' roll* (4th ed.). Thousand Oaks, CA: Sage Publications.

Fisher, D., & Frey, N. (2012). Gifted students' perspectives on an instructional framework for school improvement. *NASSP Bulletin, 96*(4), 285-301. doi:10.1177/0192636512466937

Foster, E. M., Iedell, J. E., Smith, R. M., Martens, E. H., McLeod, B., & United States Department of the Interior, O. of E. (ED). (1933). Biennial survey of education in the United States, 1930-1932. Bulletin, 1933, No. 2. Chapter VI: The education of exceptional children. *Office of Education, United States Department of the Interior*.

Fox, L. H. (1981). Identification of the academically gifted. *American Psychologist*, 36(10), 1103-111.

Freedman, J. O., & Krugman, J. O. (2001). *Access to excellence: A report of the commission on the future of the Advanced Placement Program.* New York: College Entrance Examination Board.

Frequently Asked Questions about Gifted Education (n.d.). Retrieved from https://www.nagc.org/resources-publications/resources/frequently-asked-questions-about-gifted-education

Gagnè's Differentiated Model of Giftedness and Talent (DMGT) (1999). *Journal for the Education of the Gifted, 22*, 2, 230-324.

Gallagher, J. J., & Gallagher, S. A. (1994). Teaching the gifted child (4th ed.). Needham Heights, MA: Allyn and Bacon.

Gallagher, S. (2009). Myth 19: Is advanced placement an adequate program for gifted students? *Gifted Child Quarterly, 53,* 4, 286-288.

Garber, S. (2007, October 10). Sputnik and the dawn of the space age. Retrieved from https://history.nasa.gov/sputnik/

Gardner, H. (2011). *Frames of mind: The theory of multiple intelligences* (3rd ed.). New York, NY: Basic Books.

GATE Funding frequently asked questions (2018). Retrieved from https://www.cde.ca.gov/sp/gt/gt/gatefiscalfaqs.asp

GATE Identification Process. (n.d.). Retrieved from https://achieve.lausd.net/Page/2005

GATE Testing and Identification. (n.d.). Retrieved from https://www.rbusd.org/apps/pages/index.jsp?uREC_ID=853184&type=d&pREC_ID=1219058

Geddes, K. A. (2010). Using tiered assignments to engage learners in Advanced Placement physics. *Gifted Child Today*, 33, 1, 32-40.

Gentry, M., & Owen, S. V. (2004). Secondary student perceptions of classroom quality: Instrumentation and differences between advanced/honors and nonhonors classes. Journal of Secondary Gifted Education, 16 (1), 20-29. https://doi.org/10.4219/jsge-2004-464

Gentry, M., & Springer, P. M. (2002). Secondary student perceptions of their class activities regarding meaningfulness, challenge, choice, and appeal: An initial validation study. *Journal of Secondary Gifted Education, 13,* 4, 192-204.

Gibson, K. E. (2017). *Mathematics education in one special high school for mathematically talented students* (Order No. 10255987). Available from ProQuest Dissertations & Theses Global. (1876862719). Retrieved from https://lib.pepperdine.edu/login?url=https://search-proquest-com.lib.pepperdine.edu/docview/1876862719?accountid=13159

Gifted and Talented Education. (n.d.). Retrieved from https://www.fresnounified.org/dept/curr/gate

Gifted and Talented Education (GATE): GATE in RBUSD. (n.d.). Retrieved from https://www.rbusd.org/apps/pages/index.jsp?uREC_ID=853184&type=d&pREC_ID=1219058

Gifted and Talented Education Program Resource Guide. (2005). California Department of Education. Retrieved from https://www.cde.ca.gov/sp/gt/gt/.

Gifted Education Resource Institute Instrument Repository: Student Perceptions of Classroom Quality (SPOCQ). (n.d.) Retrieved from http://purduegeri.wixsite.com/instrument/student-perceptions-of-classroom-quality

Göllner, R., Wagner, W., Eccles, J. S., & Trautwein, U. (2018). Students' idiosyncratic perceptions of teaching quality in mathematics: A result of rater tendency alone or an

expression of dyadic effects between students and teachers? *Journal of Educational Psychology, 110*(5), 709-725. http://dx.doi.org/10.1037/edu0000236

Goodhew, G. (2009). *Meeting the needs of gifted and talented students*. Retrieved from https://ebookcentral-proquest-com.lib.pepperdine.edu

Graffam, B. (2006). A case study of teachers of gifted learners: Moving from prescribed practice to described practitioners. *Gifted Child Quarterly, 50*(2), 119-131. doi:10.1177/001698620605000204

Greenes, C., & Mode, M. (1999). Empowering teachers to discover, challenge, and support students with mathematical promise. In L. J. Sheffield, *Developing mathematically promising students* (pp. 9-26). Reston, VA: The National Council of Teachers of Mathematics

Gregory, G., Kaufeldt, M., & Mattos, M. (2016). *Best practices at tier 1: Daily differentiation for effective instruction, elementary*. Bloomington, IN: Solution Tree Press, a division of Solution Tree.

Haensly, P. A. (1999). My View of the "Top 10" Events That Have Influenced the Field of Gifted Education during the Past Century. *Gifted Child Today Magazine*, *22*(6), 33–37.

Hargrove, K. (1999). The gifts of the 20th century. *Gifted Child Today Magazine, 22*(6), 38-39.

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. London ; New York: Routledge.

Heim, A. S. (1998). Gifted students and the right to an ability-appropriate education. *JL & Educ.*, *27*, 131.

Hertberg-Davis, H. (2009). Myth 7: Differentiation in the regular classroom Is equivalent to gifted programs and is sufficient—classroom teachers have the time, the skill, and the will to differentiate adequately. *Gifted Child Quarterly, 53*(4), 251-253.

Hertberg-Davis, H., & Callahan, C. M. (2008). A narrow escape: Gifted students' perceptions of Advanced Placement and International Baccalaureate programs. *Gifted Child Quarterly, 52,* 3, 199-216.

Hertberg-Davis, H., Callahan, C. M., & Kyburg, R. M. (2006). Advanced Placement and International Baccalaureate programs: A “fit” for gifted learners? Storrs, CT: National Research Center on the Gifted and Talented, University of Connecticut.

Hodges, J. (2018). Assessing the influence of no child behind on gifted education funding in Texas: A descriptive study. *Journal of Advanced Academics, 29*(4). 321-342.

Hodges, J., Tay, J., Maeda, Y., & Gentry, M. (2018). A meta-analysis of gifted and talented identification practices. *Gifted Child Quarterly, 62,* 2, 147-174.

Hollingworth, L. S. (1926). *Gifted children: Their nature and nurture*. Oxford, United Kingdom: Macmillan.

Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods*, *6*(1), 53-60.

House, P. (1999). Promises, promises, promises. In L. J. Sheffield, *Developing mathematically promising students* (pp. 9-26). Reston, VA: The National Council of Teachers of Mathematics.

Hunter, W. C., Maheady, L., Jasper, A. D., Williamson, R. L., Murley, R. C., & Stratton, E. (2015). Numbered heads together as a tier 1 instructional strategy in multitiered systems of support. *Education and Treatment of Children, 38*(3), 345-362.

Identification, Support, & FAQ. (n.d.) Retrieved from https://www.tusd.org/educational-services/gate/id-support-faq

Imbeau, M. B. (1999). A century of gifted education: A reflection of who and what made a difference. *Gifted Child Today Magazine, 22*(6), 40-43.

Johnson, E. S., Smith, L., Harris, M. L., & Mellard, D. F. (2009). *How RTI works in secondary schools*. Thousand Oaks, Calif.: Corwin.

Johnson, S. K. (2009). Practice for identifying gifted students: No single test can capture a gifted student's dynamic abilities. *Principal, 88, 8-14*. Retrieved from https://www.naesp.org/sites/default/files/resources/2/Principal/2009/M-J_p08.pdf

Johnston, R. C. & Viadero, D. (2000). Unmet Promise: Raising Minority Achievement. The Achievement Gap. *Education Week*, *19*(27). Retrieved from https://lib.pepperdine.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED458334&login.asp?custid=s8480238&site=ehost-live&scope=site

Jolly, J. L. (2004). *A conceptual history of gifted education: 1910–1940* (Order No. 3136863). Available from ProQuest Dissertations & Theses Global. (305214102). Retrieved from https://lib.pepperdine.edu/login?url=https://search-proquest-com.lib.pepperdine.edu/docview/305214102?accountid=13159

Kaplan, S. N. (2008). Layering differentiated curricula for the gifted and talented. In F. A. Karnes & M. B. Suzanne (Eds.), *Methods and materials for teaching the gifted* (2nd ed., pp. 107-132). Waco, TX: Prufock.

Kaplan, S. N. (2009). Myth 9: There is a single curriculum for the gifted. *Gifted Child Quarterly, 53,* 4, 257-258.

Kaplan, S. N. (2013). Depth and complexity. In C. M. Callahan & H. L. Hertberg-Davis (Eds.), *Fundamentals of gifted education: Considering multiple perspectives* (pp. 277-286). New York, NY: Routledge.

Kaplan, S. N., McComas, W. F., & Manzone, J. A. (2016). Teaching science and gifted students. In K. Taber & M. Sumida (Eds.), *International perspectives on science education for the gifted: Key issues and challenges* (pp. 27-42). New York, NY: Routledge.

Kern, S. (2012). *The middle school years: Supporting gifted adolescents in a regular education classroom* (Order No. 3511521). Available from ProQuest Dissertations & Theses Global. (1022973943). Retrieved from https://lib.pepperdine.edu/login?url=https://search-proquest-com.lib.pepperdine.edu/docview/1022973943?accountid=13159

Kemerer, F., & Sansom, P. (2013). *California school law* (3rd ed.). Stanford, CA: Stanford University Press.

Kitano, M. K., & DiJiosia, M. (2003). Are Asian and Pacific Americans overrepresented in programs for the gifted? *Roeper Review, 24,* 2, 76-80. DOI: 10.1080/02783190209554133

Kraeger, K. A. (2015). *Perspectives on Equity in Gifted Education* (Doctoral dissertation). Retrieved from https://digitalcommons.kennesaw.edu/etd/675

Krist, B. J. (1999). Organizational alternatives for the mathematically promising. In L. J. Sheffield, *Developing mathematically promising students* (pp. 9-26). Reston, VA: The National Council of Teachers of Mathematics.

Kurz, A., Elliot, S. N., & Roach, A. T. (2015). Addressing the missing instructional data problem: Using a teacher log to document tier 1 instruction. *Remedial and Special Education, 36*(6), 361-373.

Laine, S., & Tirri, K. (2016). How Finnish elementary school teachers meet the needs of their gifted students. *High Ability Studies, 27*(2), 149-164.

Landis, R. N., & Reschly, A. L. (2013). Reexamining gifted underachievement and dropout through the lens of student engagement. *Journal for the Education of the Gifted, 36*(2), 220-249.

Laws & Regulations (2018, August 29). Retrieved from https://www.cde.ca.gov/sp/gt/lw/

Lewis, B. A. (1996). Serving others hooks gifted students on learning. *Educational Leadership*, *53*(5), 70. Retrieved from https://lib.pepperdine.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=ulh&AN=9603191565&site=ehost-live&scope=site

Lewis, S. G., & Batts, K. (2005). How to implement differentiated instruction? Adjust, adjust, adjust: North Carolina project begins with encouragement from administrators. *Journal of staff development, 26*(4), 26-31.

Loveless, T., Farkas, S., and Duffet, A. (2008). *High achieving students in the era of NCLB*. Washington, D.C.: The Thomas B. Fordham Institute.

Lubinski, D., & Benbow, C. P. (2006). Study of mathematically precocious youth after 35 years: Uncovering antecedents for the development of math-science expertise. *Perspectives on Psychological Science*, *1*(4), 316–345. https://doi.org/10.1111/j.1745-6916.2006.00019.x

Marland, S. P. (1971). *Education of the gifted and talented-volume 1: Report to the Congress of the United States by the U.S. Commissioner of Education*. Washington, DC: Department of Education, Department of Health, Education, and Welfare.

Marotta-Garcia, C. (2011). *Teachers use of a differentiated curriculum for gifted students* (Order No. 3477957). Available from ProQuest Dissertations & Theses Global. (901460589). Retrieved from https://lib.pepperdine.edu/login?url=https://search-proquest-com.lib.pepperdine.edu/docview/901460589?accountid=13159

Martin, M. O., Mullis, I. V. S., Foy, P., & Hooper, M. (2016). *TIMSS 2015 International Results in Science.* Retrieved from Boston College, TIMSS & PIRLS International Study Center website: http://timssandpirls.bc.edu/timss2015/international-results/

Mathews, J. (1982, December 2). Jaime Escalante turns students into calculus whizzes. *The Washington Post,* Retrieved from http://www.washingtonpost.com/wp-dyn/content/article/2010/03/30/AR2010033003814.html?sid=ST2010033003904

Matsko, V. & Thomas, J. (2014). The problem is the solution: Creating original problems in gifted mathematics classes. *Journal for the Education of the Gifted, 37*(2), 153-170.

McCammon, E. (2018, November 4). A complete history of AP classes and controversies [Web log post]. Retrieved from https://blog.prepscholar.com/history-of-ap-classes-exams

Mercola, J. (2012, December 9). Use it or lose it: The principles of brain plasticity [Web log post]. Retrieved from https://www.brainhq.com/news/use-it-or-lose-it-the-principles-of-brain-plasticity

Mollison, A. (2006). Surviving a midlife crisis: Advanced Placement turns fifty. *Education Next, 1*(6), 34-39.

Mullis, I. V. S., Martin, M. O., Foy, P., & Hooper, M. (2016). *TIMSS 2015 International Results in Mathematics.* Retrieved from Boston College, TIMSS & PIRLS International Study Center website: http://timssandpirls.bc.edu/timss2015/international-results/

Myths about Gifted Students (n.d.). Retrieved from https://www.nagc.org/myths-about-gifted-students

Multiple Intelligences (n.d.). Retrieved from http://www.institute4learning.com/resources/articles/multiple-intelligences/

Multilingual and English Learner Education Definitions, 5 CCR §11300 (1998).

National Association for Gifted Children. (2015). 2014-2015 State of the states in gifted education: Policy and practice data. Retrieved from http://www.nagc.org/resources-publications/gifted-state/2014-2015-state-states-gifted-education

Neem, J. N. (2016). Path dependence and the emergence of Common Schools: Ohio to 1853. *Journal of Policy History*, *28*(1), 48–80. https://doi-org.lib.pepperdine.edu/10.1017/S0898030615000378

No Child Left Behind Act of 2002, P. L. 107-110, 20 U.S.C. § 6319 (2002).

Norris, L. A. (2013). *Middle school teachers' perspectives on differentiating instruction for gifted students* (Order No. 3601820). Available from ProQuest Dissertations & Theses Global. (1468458549). Retrieved from https://lib.pepperdine.edu/login?url=https://search-proquest-com.lib.pepperdine.edu/docview/1468458549?accountid=13159

Nugent, S. A., & Karnes, F. A. (2002). The Advanced Placement program and the International Baccalaureate programme: A history and update. *Gifted Child Today, 25, 1*, 30-39.

Oakes, J. (1986). Keeping track, part 1: The policy and practice of curriculum inequality. *The Phi Delta Kappan, 68* (1), 12-17.

Palladino, C. (2008). *Teachers' perspectives on educating the gifted learner within the regular education classroom* (Order No. 3330667). Available from ProQuest Dissertations & Theses Global. (304392405). Retrieved from https://lib.pepperdine.edu/login?url=https://search-proquest-com.lib.pepperdine.edu/docview/304392405?accountid=13159

Park, S., & Oliver, J. S. (2009). The translation of teachers understanding of gifted students into instructional strategies for teaching science. *Journal of Science Teacher Education, 20*(4), 333-351.

Plucker, J. A., & Callahan, C.M. (2014). Research on giftedness and gifted education: Status of the field and considerations for the future. *Exceptional Children*, 80(4), 390-406.

Poli, M. D. (2018). *Successful programs and strategies for secondary students who are gifted and in mathematics classes: A qualitative study.* (Order No. 10750552). Available from ProQuest Dissertations & Theses Global. (2036383414). Retrieved from https://lib.pepperdine.edu/login?url=https://search-proquest-com.lib.pepperdine.edu/docview/2036383414?accountid=13159

Raskin, B. (2017). The efficacy of advanced placement programs for gifted students. Retrieved from https://educationaladvancement.org/efficacy-advanced-placement-programs-gifted-students/

Rehm, J. (2014). Advanced Placement and American education: A Foucauldian analysis of the Advanced Placement program of the College Board (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (Order No. 3644799).

Reilly, M. L. (2014). *A comparison of teacher efficacy of teachers of gifted students in heterogenous and homogeneous classroom settings* (Order No. 3643500). Available from ProQuest Dissertations & Theses Global. (1622474407). Retrieved from https://lib.pepperdine.edu/login?url=https://search-proquest-com.lib.pepperdine.edu/docview/1622474407?accountid=13159

Renzulli, J. S. (2000). The identification and development of giftedness as a paradigm for school reform. *Journal of Science Education and Technology, 9*, 2, 95-114.

Renzulli, J. S. (2011). What makes giftedness?: Reexamining a definition. *Phi Delta Kappan*, *92*(8), 81–88. https://doi.org/10.1177/003172171109200821

Richert, E. S., Alvino, J. J., & McDonnel, R. C. (1982). *National report on identification: Assessment and recommendations for comprehensive identification of gifted and talented youth*. Sewell, N.J: Educational Improvement Center-South.

Richert, E. S., & Kansas State Board of Education, T. (1992). Equitable identification of students with gifted potential. Retrieved from https://lib.pepperdine.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED366159&login.asp?custid=s8480238&site=ehost-live&scope=site

Rockefeller Brothers Fund (1961). *Prospect for America: The Rockefeller Panel reports*. Garden City, N.Y: Doubleday & Co.

Rogers, K. B. (2007). Lessons learned about educating the gifted and talented: A synthesis of the research on educational practice. *Gifted Child Quarterly, 51,* 4, 382-396.

Rogers, K. B. (2015). The academic, socialization, and psychological effects of acceleration: Research synthesis. In Assouline, S. G., Colangelo, N., VanTassel-Baska, J., & Lupkowski-Shoplik, A. (Eds.), *A nation empowered: Evidence trumps the excuses holding back America's brightest students* (pp. 9 – 18). Iowa City, IA: Connie Belin and Jacqueline N. Blank International Center for Gifted Education and Talent Development.

Ross, P. O., & Office of Educational Research and Improvement, E. W. D. (1994). National excellence: A case for developing America's talent. An Anthology of Readings. Retrieved from https://lib.pepperdine.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED372580&login.asp?custid=s8480238&site=ehost-live&scope=site

Rothschild, E. (1999). Four decades of the Advanced Placement program. *History Teacher, 32,* 2, 175-206.

Russo, C. F. (2004). A comparative study of creativity and cognitive problem-solving strategies of high-IQ and average students. *Gifted Child Quarterly, 48*(3). 179-190.

Russo, C. J. (2001). Unequal educational opportunities for gifted students: Robbing Peter to pay Paul. *Fordham Urban Law Journal, 29*(2), 727-758.

Sapon-Shevin, M. (1994). *Playing favorites: Gifted education and the disruption of community*. Albany, N.Y: State University of New York Press.

Saul, M. (1999). A community of scholars: Working with students of high ability in the high school. In L. J. Sheffield, *Developing mathematically promising students* (pp. 9-26). Reston, VA: The National Council of Teachers of Mathematics

Sayler, M. F. (1999). American gifted education at the millennium: 150 years of experience. *Understanding our Gifted, 12*, 11-15.

Schmitt, C., & Goebel, V. (2015). Experiences of high-ability high school students: A case study. *Journal for the Education of the Gifted, 38*(4), 428-446.

Seedorf, S. M. (2011). Response to intervention: Teachers' needs for implementation in gifted and talented programs (Doctoral dissertation*).* University of Northern Colorado, Greeley, Colorado. Retrieved from http://digscholarship.unco.edu/dissertations/252

Shapiro, E. S. (n.d.). Tiered instruction and intervention in a response-to-intervention model. Retrieved from http://www.rtinetwork.org/essential/tieredinstruction/tiered-instruction-and-intervention-rti-model

Sheffield, L. J. (1999). Serving the needs of the mathematically. In L. J. Sheffield, *Developing mathematically promising students* (pp. 9-26). Reston, VA: The National Council of Teachers of Mathematics.

Siemer, E. A. (2009). *Bored out of their minds: The detrimental effects of No Child Left Behind on gifted children,* Wash. U.J.L. & Pol'y, 30, 539-560.

Solórzano, D. G., & Ornelas, A. (2002). A critical race analysis of advanced placement classes: A case of educational inequality, *Journal of Latinos and Education*, 1(4), 215 - 229, DOI: 10.1207/S1532771XJLE0104_2

Southern, W. T., & Jones, E. D. (2015). Types of acceleration: Dimensions and issues. In Assouline, S. G., Colangelo, N., VanTassel-Baska, J., & Lupkowski-Shoplik, A. (Eds.), *A nation empowered: Evidence trumps the excuses holding back America's brightest students* (pp. 9 – 18). Iowa City, IA: Connie Belin and Jacqueline N. Blank International Center for Gifted Education and Talent Development.

Standards used for identification of Gifted and Talented pupils, Categories for Identification, CA Code Regs. Title 5, §3822

Steenbergen-Hu, S., & Moon, S. (January 01, 2011). The Effects of Acceleration on High-Ability Learners: A Meta-Analysis. *Gifted Child Quarterly, 55,* 1, 39-53.

Stephens, K. R., & Karnes, F. A. (2000). State definitions for the gifted and talented revisited. *Exceptional Children, 66*(2), 219-238.

Sternberg, R. J. (2003). A broad view of intelligence: The theory of successful intelligence. *Consulting Psychology Journal: Practice & Research, 55*(3), 139-154.

Stewart, E. D. (1999). An American century of roots and signposts in gifted and talented education. *Gifted Child Today Magazine, 22*(6), 56-57.

Subotnik, R. F., Olszewski-Kubilius, P., & Worrell, F. C. (2011). Rethinking giftedness and gifted education A proposed direction forward for gifted education based on psychological science. *Gifted Child Quarterly, 56,* 4, 176-188.

TALENT Act (n.d.) Retrieved from https://www.nagc.org/get-involved/advocate-high-ability-learners/nagc-advocacy/federal-legislative-update/talent-act

Tannenbaum, A. J. (1983). *Gifted children: Psychological and educational perspectives*. New York, NY: Macmillian Publishing Co.

Terman, L. M. (1925). *Genetic studies of genius*. Stanford, CA: Stanford University Press.

Tested Ability to Leverage Exceptional National Talent Act of 2017, 5 U.S.C.A. §3171 *et seq*. (2017)

The Federal Role in Education (1997, May 25). Retrieved from https://www2.ed.gov/about/overview/fed/role.html

The Learning Network. (2012, May 17). May 17, 1954| Supreme Court declares school segregation unconstitutional in Brown v. Board of Education [Web log post]. Retrieved from https://learning.blogs.nytimes.com/2012/05/17/may-17-1954-supreme-court-declares-school-segregation-unconstitutional-in-brown-v-board-of-education/

Tomlinson, C. A. (2014). *The differentiated classroom: Responding to the needs of all learners* (2nd ed.). Alexandria, VA: ASCD.

Trilling, B. & Fadel, C. (2009). *21st century skills: Learning for life in our times.* San Francisco, CA: Jossey-Bass.

Tredick, K. (2009). *Smart reference guide: Sharp suggestions for a differentiated classroom*. Las Vegas, NV: J Taylor Education.

Urdan, T.C. (2017). *Statistics in plain English* (4th ed.). New York, NY: Routledge.

Usiskin, Z. (1999). The mathematically promising and the mathematically gifted. In L. J. Sheffield, *Developing mathematically promising students* (pp. 9-26). Reston, VA: The National Council of Teachers of Mathematics.

VanTassel-Baska, J. (2000, August). The role of Advanced Placement in talent development. Keynote address at the Advanced Placement Institute, William and Mary College. Retrieved from https://www.hoagiesgifted.org/role_of_advanced_placement.htm

VanTassel-Baska, J. (2001). The role of Advanced Placement in talent development. *Journal of Secondary Gifted Education*, 12(3), 126.

VanTassel-Baska, J. (2003). Selecting instructional strategies for gifted learners. *Focus on exceptional children, 36*(3), 1-12.

VanTassel-Baska, J. (2018). American policy in gifted education. *Gifted Child Today, 41*(2), 98-103.

VanTassel-Baska, J., & Stambaugh, T. (2005). Challenges and possibilities for serving gifted learners in the regular classroom. *Theory Into Practice, 44*(3), 211-217. doi:10.1207/s15430421tip4403_5

Webb, N. (2008). Key neurological concepts related to giftedness: The view of a psychologist. *Gifted Education Communicator*, *39*(1), 22-26.

Weintraub, N., & Erez, A. B.-H. (2009). Quality of life in school (QoLS) questionnaire: Development and validity. *American Journal of Occupational Therapy, 63*(6), 724-731. http://dx.doi.org/10.5014/ajot.63.6.724

Wertheimer, R. (1999). Definition and identification of mathematical promise. In L. J. Sheffield, *Developing mathematically promising students* (pp. 9-26). Reston, VA: The National Council of Teachers of Mathematics.

Westberg, K. L., & Daoust, M. E. (2003). *The results of the replication of the classroom practices survey replication in two states*. Retrieved from Minneapolis, MN: https://nrcgt.uconn.edu/newsletters/fall032/

Yang, Y. (2012). *The relationship between gifted and general secondary school students' perceptions of the classroom quality and their mathematics achievement in china* (Order No. 3545417). Available from ProQuest Dissertations & Theses Global. (1238326943). Retrieved from https://lib.pepperdine.edu/login?url=https://search-proquest-com.lib.pepperdine.edu/docview/1238326943?accountid=13159

Zarate, M.E., & Pachon, H. P. (2006). Equity in offering Advanced Placement courses in California high schools 1997 - 2003: Gaining or losing ground? The Tomás Rivera Policy Institute, Los Angeles, CA.

APPENDIX A

Student Perceptions of Classroom Quality Survey

Student Survey About. . .

Student Perceptions of Classroom Quality

Secondary Version

Marcia Gentry, Steven V. Owen, and Penny Springer

Student ID				A	B	C	D
0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

We would like to know how you feel about your class activities. Read each statement and show how much you agree with it by filling in the circle. There are no right or wrong answers. Your answers will be kept confidential. Remember to mark an answer for each statement. In the example below, the person agreed that the class was enjoyable. Thank you for your help in this project!

Name/ID ____________ (Optional)

Teacher ____________ School ____________

Your Current Grade in this Course

○ A ○ B ○ C ○ D ○ F

SUBJECT AREA

(please choose the answer that most closely describes the type of class in which you are completing this survey)

○ Math ○ Foreign Language
○ Science ○ Art
○ Social Studies ○ Music
○ Language Arts ○ Physical Education
○ Other: ____________

COMMUNITY

Which type of community best describes your school community?

○ Rural
○ Urban
○ Suburban

GENDER

○ Male ○ Female

ETHNIC GROUP

○ African-American
○ Asian-American
○ Caucasian-American
○ Hispanic-American
○ Native American
○ Other: ____________

Do you receive any special services from your school district?

○ Yes ○ No

If yes, what services do you receive:

○ Gifted/talented
○ English as a second language
○ Speech
○ Hearing
○ Special education-learning disability
○ Special education-behavioral services
○ Compensatory services
○ Other: ____________

Is this class an advanced level, Advanced Placement, or honors course?

○ Yes ○ No

GRADE

○ 7 ○ 9 ○ 11
○ 8 ○ 10 ○ 12

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Example: My class is enjoyable.	○	○	○	●	○
1. I am given choices regarding how to show the teacher what I have learned.	○	○	○	○	○
2. I'm good at helping other kids understand concepts.	○	○	○	○	○
3. I find the contents of my class interesting.	○	○	○	○	○
4. I find my class time instruction appropriately challenges my intellectual abilities.	○	○	○	○	○
5. My teacher lets me choose the resources I use for projects.	○	○	○	○	○
6. When there are different ways to show what I have learned, I can usually pick a good way.	○	○	○	○	○
7. The teacher applies the lessons to practical experiences.	○	○	○	○	○
8. I find my class assignments a good challenge.	○	○	○	○	○
9. The assigned reading material for my class is interesting.	○	○	○	○	○
10. My teacher makes connections between the course material and society.	○	○	○	○	○

Please continue on the back

Side 2

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
11. I learn best when I am challenged.	○	○	○	○	○
12. I am given lots of choices in my class.	○	○	○	○	○
13. In my class my teacher relates current issues to the material we are learning.	○	○	○	○	○
14. I am good at connecting material from this class with the real world.	○	○	○	○	○
15. This class content is an appropriate challenge for me.	○	○	○	○	○
16. I feel responsible for my learning because I am allowed to make choices in my class.	○	○	○	○	○
17. The teacher uses a variety of instructional techniques that make this class enjoyable.	○	○	○	○	○
18. I like the challenge of the projects in this class.	○	○	○	○	○
19. The material covered in my textbook is interesting.	○	○	○	○	○
20. The textbook provides examples of how the material relates to society and daily living.	○	○	○	○	○
21. I am good at answering questions in this class	○	○	○	○	○
22. I am encouraged to pursue subjects that interest me in my class.	○	○	○	○	○
23. It is pretty easy for me to earn good grades.	○	○	○	○	○
24. In my class I explore real issues that affect the world around me.	○	○	○	○	○
25. I look forward to learning new things in this class.	○	○	○	○	○
26. I find the reading material for my class a pleasure to read.	○	○	○	○	○
27. I use my critical thinking skills in my class.	○	○	○	○	○
28. I'm good at taking tests in this class.	○	○	○	○	○
29. I can relate the material discussed in my class to my daily life.	○	○	○	○	○
30. I can easily understand reading assignments for this class	○	○	○	○	○
31. I like going to my class each day.	○	○	○	○	○
32. I can usually discover interesting things to learn about in this class.	○	○	○	○	○
33. I like the way my teacher challenges me in this class.	○	○	○	○	○
34. I can express my opinions clearly in this class.	○	○	○	○	○
35. Good grades are mainly the result of my hard work.	○	○	○	○	○
36. Good grades are mainly the result of my ability.	○	○	○	○	○
37. I can improve my intelligence by working hard.	○	○	○	○	○
38. I plan to go to college.	○	○	○	○	○

01021

APPENDIX B

Data Summary of Demographics of Schools in Study

Table B1

Data Summary of Demographics of Schools

	Overall Demographics for 2017-2018 School Year	AP Results in AP Math Courses in May 2018 **(AP Calc AB, AP Calc BC, AP Stats)**	CAASPP Math Results May 2018	Students Enrolled in AP Courses	Number of Gifted
WHS	2042 students with 397 students receiving free or reduced meals, 158 English Language Learners, 37.8% white, 30.1% Asian, 17.5% Hispanic, 6% two or more races, 3.4% Filipino, 2.2% African American or Black, 0.3% Native Hawaiian or Pacific Islander, and 0.2% American Indian or Alaska Native.	5 = 74 4 = 35 3 = 26 2 = 10 1 = 5 Avg. Score = 4.087 Total Math Tests taken = 150	Standard Exceeded = 34.6% Standard Met = 31.0% Standard Nearly Met = 21.1% Standard Not Met = 13.3%	Teacher A = 61 Teacher B = 46 Teacher C/Stats = 35 Total = 142	Teacher A = 13 Teacher B = 12 Teacher C = 13 Total = 38
XHS	2031 students with 458 students receiving free or reduced meals, 147 English Language Learners, 36.9% Asian, 23.2% white, 20.1% Hispanic, 8.1% two or more races, 4.1% African American or Black, 5.3% Filipino, 0.2% American Indian or Alaska Native, and 0.1% Native Hawaiian or Pacific Islander	5 = 82 4 = 46 3 = 54 2 = 23 1 = 6 Avg. Score = 3.829 Total Math Tests taken = 211	Standard Exceeded = 31.7% Standard Met = 26.5% Standard Nearly Met = 20.7% Standard Not Met = 21.1%	Teacher D = 53 Teacher E = 67 Teacher F = 77 Teacher G/Stats = 28 Total = 225	Teacher D = 23 Teacher E = 31 Teacher F = 52 Teacher G = 8 Total = 114

(continued)

Table B1 (continued)

	Overall Demographics for 2017-2018 School Year	AP Results in AP Math Courses in May 2018 **(AP Calc AB, AP Calc BC, AP Stats)**	CAASPP Math Results May 2018	Students Enrolled in AP Courses	Number of Gifted
YHS	1954 students with 677 students receiving free or reduced meals, 192 English Language Learners, 41.2% Hispanic, 18.1% Asian, 16% white, 11.8% Filipino, 6.6% two or more races, 3.7% African American or Black, 0.5% Native Hawaiian or Pacific Islander, and 0.4% American Indian or Alaska Native	Could Not Attain this data!	Standard Exceeded = 21.9% Standard Met = 30.8% Standard Nearly Met = 25.2% Standard Not Met = 22.1%	Teacher H = 70 Teacher I = 45 Total = 115 No AP Stats this year	Teacher H = 17 Teacher I = 24 Total = 41
ZHS	1846 students with 816 students receiving free or reduced meals, 169 English Language Learners, 42.7% Hispanic, 25.1% Asian, 12.4% white, 7% African American or Black, 5.6% two or more races, 4.9% Filipino, 0.8% Native Hawaiian or Pacific Islander, and 0.1% American Indian or Alaska Native	5 = 16 4 = 31 3 = 34 2 = 30 1 = 26 Avg. Score = 2.861 Total Math Tests taken =137	Standard Exceeded = 13.2% Standard Met = 24.8% Standard Nearly Met = 29.7% Standard Not Met = 29.3%	Teacher J = 66 Teacher K = 26 Teacher L/Stats = 38 Total = 130	Teacher J = 23 Teacher K = 8 Teacher L = 14 Total = 45
Total				612	238

APPENDIX C

School District Research Application

[redacted] SCHOOL DISTRICT
APPLICATION TO CONDUCT RESEARCH

Please ensure all necessary support documents accompany this research application. Completing this application does not guarantee approval to conduct research. You will be notified of approval within 5-10 school days of the completed application.

Name: **Emma Biggs** Title : **Teacher/Researcher**

University/Organization: **Pepperdine University**

Email: [redacted] Phone: [redacted]

Name of Supervising Educator for the Research: **Dr. Doug Leigh**

Title: **Professor; Dissertation Chair** Ema[redacted]

Phone: [redacted]

Title of Research:
The Perceived Appeal, Challenge, and Learning Choice for Gifted and Talented Students in Advanced Placement Mathematics Courses

Research Question(s):
To what extent, if at all, do differences exist in perceptions of appeal, challenge and learning choice in high school AP mathematics courses between AP students who were previously identified as gifted and talented versus a matched group of those who were not?

Please summarize the research project making sure to specifically describe how the research would be conducted in the [redacted]

This quantitative, comparative, and quasi-experimental study examines the phenomena of the high school students' current perceptions of appeal, challenge, and learning choice in high school AP mathematics courses in the affective domain using portions of the Student Perceptions of Classroom Quality (SPOCQ) instrument (Gentry & Owen, 2004). To accomplish this purpose a survey will be given to students currently enrolled in an AP Mathematics course near the end of the course requirements. The results will be analyzed to explore if any differences exist between the two populations of students in these accelerated, college-level courses.

This research approach was designed to allow for a comparison of the perceived perceptions of gifted and talented students versus a matched group of nongifted students enrolled in AP mathematics courses. In this study, appeal refers to students' interest and enjoyment of the AP math course, while also reflecting the safe, satisfying, and engaging classroom environment (Gentry & Owen). Appeal will be measured using seven items on the SPOCQ instrument (Gentry & Owen). Challenge indicates students participating in effective learning involving depth, complexity, rigor while examining math content, processes, and products (Gentry & Owen). Challenge will be measured using seven survey questions from the SPOCQ instrument (Gentry & Owen). Learning choice references students leading decisions about their learning to take ownership and increase motivation (Gentry & Owen). Learning choice will be measured using seven questions on the SPOCQ instrument (Gentry & Owen).

For cost-effective purposes and ease of data analysis, a self-reporting internet questionnaire will be employed to cross-sectionally gather data at the interval level for each of the phenomena studied. Students previously-identified as GT and nongifted who are currently enrolled in AP mathematics courses of AP Calculus AB, AP Calculus BC, and AP Statistics will complete the questionnaire between the two-week period of May 15, 2019 and May 29, 2019, to allow for a majority of students' AP experience in the survey results. During this time period, students may be taking AP exams for their mathematics courses, if they have elected to do so, along with other AP exams. A majority of students enrolled in these courses are in eleventh and twelfth grade. Students who dropped out of the course at any point during the school year will not be eligible for participation in this study.

Why are you requesting [redacted] for your research?

I currently work in [redacted] and have a relationship with a majority of the AP Mathematics teachers at the high schools. The four high schools in [redacted] have a sizable population of AP mathematics students, which is needed for my quantitate study.

What is the anticipated time required to complete this project:

Teachers will need to distribute parental consent forms to students, collect the forms back from students, hand students a piece of paper with directions to students, and place the consent forms in an envelope for mailing back to the researcher. Included in the mailing, AP teachers will be asked to add a class list to confirm participants have received consent. Teachers may also need to obtain school chromebooks for students to take their survey if students do not already have their own smart phone or laptop.
Students will need to obtain a parent signed consent form and return to their AP math teacher. Students will need to follow a supplied link to complete a survey that should take no more than 10 minutes.

Describe the potential benefit to [redacted] School District students or the educational system:

It is hoped that the results from this study will truthfully depict the perceptions of gifted and talented students and their non-gifted peers in relation to their experiences in their Advanced Placement mathematics course(s). Additionally, the information amassed in this study is hoped to add to the body of literature around the needs of the gifted and talented. Furthermore, the evidence gathered in this study adds to the body of knowledge regarding the Advanced Placement program. The evidence gathered in this study may assist educators of the gifted and talented in AP mathematics courses and the College Board in designing courses to meet the specific needs of the gifted and talented population leading to equity of outcomes and participation in their classrooms for all students.

I understand:

The district does not recruit subjects, reproduce forms or other paperwork for research projects and does not collect and monitor materials.

The district does not allow for the individual interviewing of students.

Research projects may not dispense medications or recommend parents or children to physicians or agencies.

Upon completion, a copy of the results must be submitted to [redacted] School District,
[redacted]

Applicant's Name (please print): **Emma Biggs** Date: **March 29, 2019**

Applicant's Signature: [redacted]

Research Approval: ________________________________ Date: _____________
Chief Academic Officer

APPENDIX D

Qualtrics Survey with Student Consent

Link:

https://pepperdinegsep.az1.qualtrics.com/jfe/form/SV_bdsZn5BufDmSPCR

Shortened Link:

https://bit.ly/2SVZDWS

Perception of Appeal, Learning Choice, and Challenge in AP Mathematics Courses

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Start of Block: Block 2

PEPPERDINE UNIVERSITY

Graduate School of Education and Psychology

INFORMED CONSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

"THE PERCEIVED APPEAL, CHALLENGE, AND LEARNING CHOICE FOR GIFTED AND TALENTED STUDENTS IN ADVANCED PLACEMENT MATHEMATICS COURSES"

You are invited to participate in a research study conducted by Emma Biggs, Doctoral Student of Education in Educational Leadership, Administration, and Policy with Dr. Douglas Leigh, Committee Chair, at Pepperdine University, because you are enrolled in an Advanced Placement Mathematics course. Your participation is voluntary. Please read the information below and ask questions about things you do not understand before deciding that you want to participate in the study. Please take as much time as you need to read this form. You may also discuss participation with family and friends.

PURPOSE OF THE STUDY

The purpose of this quantitative, comparative, quasi-experimental study is to identify what differences, if any, exist in the perceived appeal, challenge, and learning choice in high school Advanced Placement (AP) mathematics courses between AP students who were previously identified as gifted and talented versus a matched group of those who were not. To accomplish this purpose a survey will be given to students currently enrolled in an AP Mathematics course near the end of the course requirements. The results will be analyzed to explore if any differences exist between the two populations of students in these accelerated, college-level courses.

STUDY PROCEDURES

If you volunteer to participate in this study, you will be asked to participate in an online survey that should take no more than 10 minutes to complete. You will be given time to complete the online survey during class. Your participation grants the researcher access your historical district-level academic data for possible longitudinal analysis.

POTENTIAL RISKS AND DISCOMFORTS

The potential and foreseeable risks associated with participation in the study are minimal. Risks of participation may include looking more in-depth at the AP mathematics course and the instructional techniques used in the classroom. This may lead to dissatisfaction with the coursework and eventually a lack of engagement or participation. Participants may also feel boredom and fatigue while taking the survey.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

While there are no direct benefits to the study participants, there are several anticipated benefits to society which include contribution to the knowledge surrounding the needs of identified gifted and talented students in AP mathematics classrooms and assisting educators and the College Board in designing courses to meet the specific needs of the gifted and talented population leading to equity of outcomes and participation in their classrooms for all students.

CONFIDENTIALITY

The records collected for this study will be confidential as far as permitted by law. However, if required to do so by law, it may be necessary to disclose information collected about you. Examples of the types of issues that would require me to break confidentiality are if the participant discloses any instances of child abuse or harm to self or others. Pepperdine University's Human Subjects Protection Program (HSPP) may also access the data collected. The HSPP occasionally reviews and monitors research studies to protect the rights and welfare of research subjects.

The data will be stored for a minimum of three years on a password protected computer in the researcher's place of residence. The data collected will be de-identified. Any identifiable information obtained in connection with this study will remain confidential. When the results of this project are presented, the names of the participants and schools in the study will not be revealed. Participants and the schools will be assigned pseudonyms to maintain confidentiality.

SUSPECTED NEGLECT OR ABUSE OF CHILDREN

Under California law, the researcher, who is a mandated reporter, will not keep confidential any information about known or reasonably suspected incidents of abuse or neglect of a child, dependent adult or elder, including, but not limited to, physical, sexual, emotional, and financial abuse or neglect. If any researcher has or is given such information, he or she is required to report this abuse to the proper authorities.

PARTICIPATION AND WITHDRAWAL

Your participation is voluntary. Your refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may withdraw your assent at any time and discontinue your participation without penalty. You are not waiving any legal claims, rights or remedies due to your participation in this research study. Your participation grants the researcher access to your historical district-level academic data for possible longitudinal analysis.

ALTERNATIVES TO FULL PARTICIPATION

The alternative to full participation in the study is not participating or only completing the items for which you feel comfortable. Participation in this study will not in any way, shape or form infringe upon the relationship between you and your educational institution.

EMERGENCY CARE AND COMPENSATION FOR INJURY

If you are injured as a direct result of research procedures you will receive medical treatment; however, you or your insurance will be responsible for the cost. Pepperdine University does not provide any monetary compensation for injury.

INVESTIGATOR'S CONTACT INFORMATION

The investigator is willing to answer any inquiries you may have concerning the research herein described. If you have questions or concerns about the research, please contact Emma Biggs (Researcher) via email at [redacted] or by phone at [redacted] or Dr. Doug Leigh (Committee Chair) via email at [redacted] or by phone at [redacted].

RIGHTS OF RESEARCH PARTICIPANT- IRB CONTACT INFORMATION

If you have questions, concerns, or complaints about your rights as a research participant or this research, please contact [redacted], (Pepperdine Graduate School IRB Chairperson) at [redacted] or via email at [redacted].

I have read the information provided above. I have been given a chance to ask questions. My questions have been answered to my satisfaction and I agree to participate in this study.

○ I agree to participate in this study. (1)

○ I do not want to participate in this study. (2)

I grant permission for the researcher to access my historical district-level academic data for possible longitudinal analysis.

○ I agree (1)

○ I disagree (2)

End of Block: Block 2

Start of Block: SPOCQ Questions

We would like to know how you feel about your class activities. Read each statement and show how much you agree with it by filling in the circle. There are no right or wrong answers. Your answers will be kept confidential. Remember to mark an answer for each statement. Thank you for your help in this project.

Q1. I am given choices regarding how to show the teacher what I have learned.

- ◯ Strongly Disagree (1)
- ◯ Disagree (2)
- ◯ Undecided (3)
- ◯ Agree (4)
- ◯ Strongly Agree (5)

Q2. I find the contents of my class interesting.

- ◯ Strongly Disagree (1)
- ◯ Disagree (2)
- ◯ Undecided (3)
- ◯ Agree (4)
- ◯ Strongly Agree (5)

Q3. I find my class time instruction appropriately challenges my intellectual abilities.

- ◯ Strongly Disagree (1)
- ◯ Disagree (2)
- ◯ Undecided (3)
- ◯ Agree (4)
- ◯ Strongly Agree (5)

Q4. My teacher lets me choose the resources I use for projects.

- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Undecided (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q5. When there are different ways to show what I have learned I can usually pick a good way.

- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Undecided (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q6. I find my class assignments a good challenge.

- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Undecided (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q7. The assigned reading material for my class is interesting.

- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Undecided (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q8. I learn best when I am challenged.

- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Undecided (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q9. I am given lots of choices in my class.

- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Undecided (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q10. This class content is an appropriate challenge for me.

- Strongly Disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly Agree (5)

Q11. I feel responsible for my learning because I am allowed to make choices in my class.

- Strongly Disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly Agree (5)

Q12. The teacher uses a variety of instructional techniques that make this class enjoyable.

- Strongly Disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly Agree (5)

Q13. I like the challenge of the projects in this class.

- ◯ Strongly Disagree (1)
- ◯ Disagree (2)
- ◯ Undecided (3)
- ◯ Agree (4)
- ◯ Strongly Agree (5)

Q14. The material covered in my textbook is interesting.

- ◯ Strongly Disagree (1)
- ◯ Disagree (2)
- ◯ Undecided (3)
- ◯ Agree (4)
- ◯ Strongly Agree (5)

Q15. The textbook provides examples of how the material relates to society and daily living.

- ◯ Strongly Disagree (1)
- ◯ Disagree (2)
- ◯ Undecided (3)
- ◯ Agree (4)
- ◯ Strongly Agree (5)

Q16. I am encouraged to pursue subjects that interest me in class.

- ◯ Strongly Disagree (1)
- ◯ Disagree (2)
- ◯ Undecided (3)
- ◯ Agree (4)
- ◯ Strongly Agree (5)

Q17. I look forward to learning new things in class.

- ◯ Strongly Disagree (1)
- ◯ Disagree (2)
- ◯ Undecided (3)
- ◯ Agree (4)
- ◯ Strongly Agree (5)

Q18. I find the reading material for my class a pleasure to read.

- ◯ Strongly Disagree (1)
- ◯ Disagree (2)
- ◯ Undecided (3)
- ◯ Agree (4)
- ◯ Strongly Agree (5)

Q19. I use my critical thinking skills in class.

- Strongly Disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly Agree (5)

Q20. I like going to my class each day.

- Strongly Disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly Agree (5)

Q21. I like the way my teacher challenges me in class.

- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Undecided (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q22. I feel like the pace of this course if just right for me.

- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Undecided (3)
- ○ Agree (4)
- ○ Strongly Agree (5)

Q23. If my school offers an intervention/workshop/tutorial period, I feel like it enriches the curriculum of this course for me.

- ◯ Strongly Disagree (1)
- ◯ Disagree (2)
- ◯ Undecided (3)
- ◯ Agree (4)
- ◯ Strongly Agree (5)
- ◯ Does Not Apply (6)

Q24. If my school offers an intervention/workshop/tutorial period, I feel like it provides support to allow me to be successful in this course.

- ◯ Strongly Disagree (1)
- ◯ Disagree (2)
- ◯ Undecided (3)
- ◯ Agree (4)
- ◯ Strongly Agree (5)
- ◯ Does Not Apply (6)

End of Block: SPOCQ Questions

Start of Block: Demographics

Q25. Please type your student ID number in the provided text box.

____

Q26. Select your gender

- ○ Male (1)
- ○ Female (2)

Q27. Select your grade

- ○ 8th (1)
- ○ 9th (2)
- ○ 10th (3)
- ○ 11th (4)
- ○ 12th (5)

Q28. Ethnic Group

- ○ African American (1)
- ○ Asian (2)
- ○ Caucasian, Not of Hispanic Origin (3)
- ○ Filipino (4)
- ○ Hispanic or Latino (5)
- ○ Native American or Alaska Native (6)
- ○ Pacific Islander (7)
- ○ Other (8)
- ○ Two or More Races (9)

Q29. Please chose the answer that describes the class in which you are completing the survey (If you take more than one of these courses currently, select both)

- ☐ AP Calculus AB (1)
- ☐ AP Calculus BC (2)
- ☐ AP Statistics (3)

Q30. Why did you enroll in the course(s) you identified in the previous question? (Mark as many reasons as desired)

- ☐ I desired to take this course.
- ☐ It was the only math course option available to me.
- ☐ My parents forced me to enroll.
- ☐ My counselor forced me to enroll.
- ☐ I wanted the GPA boost.
- ☐ I wanted to boost my college application with the AP designation.
- ☐ I wanted to challenge myself.
- ☐ I really like mathematics
- ☐ Other (Please type in the text box) ________________________

Q31. What was your first-semester grade in the course in which you are completing this survey?

- ○ A (1)
- ○ B (2)
- ○ C (3)
- ○ D (4)
- ○ F (5)

Q32. Which school are you currently enrolled in?

- ○ [redacted] High School (1)
- ○ [redacted] High School (2)
- ○ [redacted] High School (3)
- ○ [redacted] High School (4)

Q33. Select which service(s), if any, that you receive from the school district?

- ▢ Identification as Gifted/Talented (GATE)
- ▢ English as a second language or English Language Learner
- ▢ Speech
- ▢ Hearing
- ▢ Special Education - Learning disability
- ▢ Special Education - Behavioral services
- ▢ Free or Reduced Lunch
- ▢ None of the Above

End of Block: Demographics

APPENDIX E

Email to School Principal

Dear esteemed high school principals of [redacted] School District,

I have been working on my doctorate for the last three years and am currently completing my dissertation study. I am planning on presenting my first three chapters of my dissertation on April 16th, and hopefully proceeding to Institutional Review Board (IRB) to receive permission to collect data immediately following. I need to collect data before school gets out or I will be delayed almost a year. I have received permission from [redacted] to conduct my study in [redacted] and hope you grant permission for me to collect data from your AP mathematics students. I am studying the differences in perception between AP mathematics students previously identified as GATE and those not identified in the areas of appeal, challenge, and learning choice.

I have attached my approval letter from [redacted], my application to conduct research in [redacted], a draft of my parental consent form, and a PDF of the online survey I plan to administer to willing student participants. The application describes the participation of teachers and students, but in summary teachers need to distribute, collect, and return to me in pre-paid mailing envelope parental consent forms, as well as give up ten minutes of class to give an online survey on either student smartphones or school Chromebooks. The survey time frame would be after the AP exams.

If you approve of my collection of data, I **need a letter on school leader head.** I have attached a Word Document with a sample of the wording needed by IRB. You would just need to copy the wording on to school letter head and change the pieces in red to reflect the school name and correct date, as well as sign and date.

Thank you in advance!

Mrs. Emma Biggs

APPENDIX F

Email to Teachers Seeking Permission to Survey Their Students

Dear esteemed AP Mathematics teachers of [redacted] School District,

I have been working on my doctorate for the last three years and am currently completing my dissertation study. I am studying the differences in perception between AP mathematics students previously identified as gifted and talented versus those not identified as gifted and talented in the areas of appeal, challenge, and learning choice. I have received permission from [redacted] and your principal to conduct my study with your students. I am reaching out to explain your minimal participation in my study and hopefully gain your approval to survey your students assuming parental consent is obtained. The survey itself should take no more than 10 minutes of class time. Students will complete 21 Likert scale questions on the three variables and answer 7 demographic questions.

Here are the things I am asking of you:

1. You will need to distribute parental consent forms on May 13, 2019 to all students currently enrolled in your AP Calculus AB, AP Calculus BC, and AP Statistics courses. Students will need to take these forms home to have their parents read the consent form and sign the third page to return, if they agree to their student participating.
2. You will need to verbally tell students that their participation in the research survey is voluntary and does not impact their grades or AP scores, or collect any identifying information.
3. You will need to print off a class roster in PowerSchool with student ID numbers and check off students as the forms are collected, and place the class roster, all informed consent forms, and the student directions in an envelope that has the pre-paid postage provided to be sealed and mailed back to me on May 30, 2019.
4. You will need to pick a day between May 15, 2019 and prior to the close of the survey on May 29, 2019 at 11:59 pm for students to complete the 10-minute survey in class.
5. You may need to obtain or check-out Chromebooks or other school electronic devices if students do not have access to personal electronic devices or smart phones on your chosen day.
6. You will need to hand each student who returned a parental consent form, the slip of paper titled Student Directions for the survey on your chosen day for the survey, and collect them back to possibly use with other class periods.

I need to collect data before school gets out or I will be delayed almost a year in completing my dissertation.

<u>Please reply as soon as possible</u>, so I may drop off the teacher directions, parental consent forms, and student directions at your school site.

If you have any questions or concerns, I can be reached via email me at [redacted] or phone at [redacted].

Thank you in advance!

Mrs. Emma Biggs

APPENDIX G

Parental Consent Form

Graduate School of Education and Psychology

PARENT/LEGAL GUARDIAN CONSENT TO PARTICIPATE IN RESEARCH

"THE PERCEIVED APPEAL, CHALLENGE, AND LEARNING CHOICE FOR GIFTED AND TALENTED STUDENTS IN ADVANCED PLACEMENT MATHEMATICS COURSES"

Your child is invited to participate in a research study conducted by Emma Biggs, Doctoral Student of Education in Educational Leadership, Administration, and Policy with Dr. Douglas Leigh, Committee Chair, at Pepperdine University, because your student is enrolled in an Advanced Placement Mathematics course. Your student's participation is voluntary. Please read the information below and ask questions about things you do not understand before deciding that your child can participate in the study. Please take as much time as you need to read this form. You may also discuss participation with family and friends. You will be given a copy of this form for your records.

PURPOSE OF THE STUDY

The purpose of this quantitative, comparative, quasi-experimental study is to identify what differences, if any, exist in the perceived appeal, challenge, and learning choice in high school Advanced Placement (AP) mathematics courses between AP students who were previously identified as gifted and talented versus a matched group of those who were not. To accomplish this purpose a survey will be given to students currently enrolled in an AP Mathematics course near the end of the course requirements. The results will be analyzed to explore if any differences exist between the two populations of students in these accelerated, college-level courses.

STUDY PROCEDURES

If your student volunteers to participate in this study, the student will be asked to participate in an online survey that should take no more than 10 minutes to complete. Students will be given time to complete the online survey during class. Your child's participation involves granting the researcher permission to access your child's historical district-level academic data for possible longitudinal analysis.

POTENTIAL RISKS AND DISCOMFORTS

The potential and foreseeable risks associated with participation in the study are minimal. Risks of participation may include looking more in-depth at the AP mathematics course and the instructional techniques used in the classroom. This may lead to dissatisfaction with the coursework and eventually a lack of engagement or participation. Participants may also feel boredom and fatigue while taking the survey.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

While there are no direct benefits to the study participants, there are several anticipated benefits to society which include contribution to the knowledge surrounding the needs of identified gifted and talented students in AP mathematics classrooms and assisting educators and the College Board in designing courses to meet the specific needs of the gifted and talented population leading to equity of outcomes and participation in their classrooms for all students.

CONFIDENTIALITY

The records collected for this study will be confidential as far as permitted by law. However, if required to do so by law, it may be necessary to disclose information collected about you. Examples of the types of issues that would require me to break confidentiality are if the participant discloses any instances of child abuse or harm to self or others. Pepperdine University's Human Subjects Protection Program (HSPP) may also access the data collected. The HSPP occasionally reviews and monitors research studies to protect the rights and welfare of research subjects.

The data will be stored for a minimum of three years on a password protected computer in the researcher's place of residence. The data collected will be de-identified. Any identifiable information obtained in connection with this study will remain confidential. When the results of this project are presented, the names of the participants and schools in the study will not be revealed. Participants and the schools will be assigned pseudonyms to maintain confidentiality

SUSPECTED NEGLECT OR ABUSE OF CHILDREN

Under California law, the researcher, who is a mandated reporter, will not keep confidential any information about known or reasonably suspected incidents of abuse or neglect of a child, dependent adult or elder, including, but not limited to, physical, sexual, emotional, and financial abuse or neglect. If any researcher has or is given such information, he or she is required to report this abuse to the proper authorities.

PARTICIPATION AND WITHDRAWAL

Your student's participation is voluntary. Your refusal to have your student participate will involve no penalty or loss of benefits to which you or your child are otherwise entitled. You may withdraw your consent at any time and discontinue your child's participation without penalty. You are not waiving any legal claims, rights or remedies due to your participation in this research study. Your child's participation grants the researcher access to your child's historical district-level academic data for possible longitudinal analysis.

ALTERNATIVES TO FULL PARTICIPATION

The alternative to full participation in the study is not participating or your student only completing the items for which your student feels comfortable. Participation in this study will not in any way, shape or form infringe upon the relationship between you and your education institution.

EMERGENCY CARE AND COMPENSATION FOR INJURY

If your student is injured as a direct result of research procedures your student will receive medical treatment; however, you or your insurance will be responsible for the cost. Pepperdine University does not provide any monetary compensation for injury.

INVESTIGATOR'S CONTACT INFORMATION

The investigator is willing to answer any inquiries you may have concerning the research herein described. If you have questions or concerns about the research, please contact Emma Biggs (Researcher) via email at [redacted] or by phone at [redacted] or Dr. Doug Leigh (Committee Chair) via email at [redacted] or by phone at [redacted]

RIGHTS OF RESEARCH PARTICIPANT- IRB CONTACT INFORMATION

If you have questions, concerns, or complaints about your rights as a research participant or this research, please contact: [redacted], (Pepperdine Graduate School IRB Chairperson) at [redacted] or via email at [redacted].

If you have any questions, you may contact me at [redacted].

You may keep a copy of this form if you wish.

<u>Parent consent:</u>

I agree to have my child participate in this research study conducted by Emma Biggs, Doctoral student at Pepperdine University.

Student Participant's printed name: ___________________________

Student Participant's Student ID number: ______________________

________________________________ ________________________

Parent's signature Date

________________________________ ________________________

Researcher's signature Date

APPENDIX H

Letter for Teachers included in Mailing with Consent Forms

Dear Teacher,

Thank you in advance for your support in assisting in the completion of my dissertation research. I am studying the differences in perception between AP mathematics students previously identified as gifted and talented and those not identified as gifted and talented in the areas of appeal, challenge, and learning choice. I am truly appreciative of your assistance in observing the procedures outlined below to collect parental consent forms and have students submit survey responses. To clarify the process involved and your limited participation in this study, I have outlined the steps that need to be taken below.

1. On May 13, 2019, please distribute the parent informed consent form to all students currently enrolled in your AP Calculus AB, AP Calculus BC, and AP Statistics courses. Do not distribute the survey to any students who dropped out of the course at any point during the school year. Please ask students to have their parents read the consent form and sign the third page to return, if they agree to their student participating. If students or their parents have questions about the research and/or the survey, please direct them to research out to me via the contact information provided on the third page of the consent form. Please tell students that their participation in the research survey is voluntary and does not impact their grades or AP scores, or collect any identifying information.
2. Please print off a class roster in PowerSchool with student ID numbers and check off students as the forms are collected. To print the class roster, go into PowerTeacher Pro, click on reports, select student roster, under Sort options, choose student number, then click any additional columns that would make it easy for you to track forms turned in. Select Run Report at the bottom right of the screen. The report will now be in your reporting que to open and print. Place the class roster and all informed consent forms in the envelope that has the pre-paid postage provided.
3. Pick a day between May 15, 2019 and prior to the close of the survey on May 29, 2019 at 11:59 pm for students to complete the 10-minute survey in class. Students may use smart phones or other electronic devices to complete the survey. If students do not have personal devices, you may need to utilize school devices or Chromebooks.
4. On the chosen day, please hand each student who returned a parental consent form, the slip of paper titled Student Directions for the survey. Students are to navigate to the survey using either the bit.ly web address or the QR code. Students will have the choice to assent to taking the survey or not after reaching through the assent welcome page. If at that time, students have questions about the research and/or survey, please instruct them to email or call me. They may take the survey at a later date after their questions are sufficiently answered. After students have taken the survey, collect the slip of paper with the bit.ly link and the QR code to reuse with further classes if needed, as well as return in the provided envelope with the consent forms. For students who hand in the parental consent form following your selected class date for the survey, please hand them the directions for the survey, which they may complete on their own time.
5. Students who do not turn in the parental consent form can work on an assignment at your direction.

6. On May 30, 2019, please securely close the envelope with all the informed consents and the class roster. Place the envelope in the mail to be returned to the researcher.

For your information, the survey link will open with a welcome message, assent information where students have a choice of assent or decline of participation. When students assent, the second page will contain twenty-one Likert scale survey questions. The third page of the Qualtrics survey will collect participant grouping demographic data and the fourth page will be a thank you message. Students who decline participation will immediately be led to a thank you page.

If you have any questions, please reach out to me via email at [redacted] or by phone at [redacted].

Thank you again!

Mrs. Emma Biggs

APPENDIX I

Student Directions for Survey

Please enter the link https://bit.ly/2SVZDWS into a browser on a mobile device or computer. Follow the directions on the browser.

Alternatively, scan the QR code below using the camera on a smartphone or a QR reader application. Proceed to follow the directions on the browser.

APPENDIX J

Follow-up Email to Teachers

Date of preparation

Dear_______,

This is a follow-up email to remind you to distribute the parental consent forms, if not already completed, to collect the parental consent forms, to pick a day for students to take the survey and then distribute the student directions for the survey to students who have returned the parental consent form. The survey closes on May 29, 2019 at 11:59 pm.

Your students' input will be valued for this research study as your students are currently enrolled in an AP mathematics course and will be able to share their perceptions.

You may reach me via email at [redacted] or via phone at [redacted] if you have any questions or concerns.

Sincerely,

Emma Biggs, Doctoral Student

Pepperdine University

[redacted]

APPENDIX K

IRB Approval

Pepperdine University
24255 Pacific Coast Highway
Malibu, CA 90263
TEL: 310-506-4000

NOTICE OF APPROVAL FOR HUMAN RESEARCH

Date: May 09, 2019

Protocol Investigator Name: Emma Biggs

Protocol #: 19-04-1033

Project Title: THE PERCEIVED APPEAL, CHALLENGE, AND LEARNING CHOICE FOR GIFTED AND TALENTED STUDENTS IN ADVANCED PLACEMENT MATHEMATICS COURSES

School: Graduate School of Education and Psychology

Dear Emma Biggs:

Thank you for submitting your application for expedited review to Pepperdine University's Institutional Review Board (IRB). We appreciate the work you have done on your proposal. The IRB has reviewed your submitted IRB application and all ancillary materials. As the nature of the research met the requirements for expedited review under provision Title 45 CFR 46.110 of the federal Protection of Human Subjects Act, the IRB conducted a formal, but expedited, review of your application materials.

Based upon review, your IRB application has been approved. The IRB approval begins today May 09, 2019, and expires on May 08, 2020.

Your final consent form has been stamped by the IRB to indicate the expiration date of study approval. You can only use copies of the consent that have been stamped with the IRB expiration date to obtain consent from your participants.

Your research must be conducted according to the proposal that was submitted to the IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit an amendment to the IRB. Please be aware that changes to your protocol may prevent the research from qualifying for expedited review and will require a submission of a new IRB application or other materials to the IRB. If contact with subjects will extend beyond May 08, 2020, a continuing review must be submitted at least one month prior to the expiration date of study approval to avoid a lapse in approval.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite the best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the IRB as soon as possible. We will ask for a complete written explanation of the event and your written response. Other actions also may be required depending on the nature of the event. Details regarding the timeframe in which adverse events must be reported to the IRB and documenting the adverse event can be found in the *Pepperdine University Protection of Human Participants in Research: Policies and Procedures Manual* at community.pepperdine.edu/irb.

Please refer to the protocol number denoted above in all communication or correspondence related to your application and this approval. Should you have additional questions or require clarification of the contents of this letter, please contact the IRB Office. On behalf of the IRB, I wish you success in this scholarly pursuit.

PEPPERDINE

Pepperdine University
24255 Pacific Coast Highway
Malibu, CA 90263
TEL: 310-506-4000

Sincerely,

Judy Ho, Ph.D., IRB Chair

cc: Mrs. Katy Carr, Assistant Provost for Research