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Curricular Policy Changes and College Readiness

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This is to certify that the doctoral study by

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Walden University
2020

Abstract

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by

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MA, Loyola Marymount University, 1992

BS, Loyola Marymount University, 1987

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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November 2020

Abstract

The problem addressed in this study was the uncertain influence of a local curricular policy change. Educators, policymakers, and communities need more data to determine the usefulness of changes in policy and practice because changes involve restructuring, resource allocation, and understanding the intended and unintended consequences of policy implementation. In the United States, fewer than 50% of high school graduates complete a college preparatory curriculum and are eligible to enter 4-year public state universities. The purpose of this ex post facto study was to investigate how a change in local curricular policy might have influenced high school graduates' college readiness as measured by high school GPA. Conley's framework of the four keys of college readiness and high school GPA was used. Archival student data from a western school district included 79,194 scores from the prepolicy cohort and 81,816 from the postpolicy cohort. Independent samples *t*-test results indicated a statistically significant decline in GPA, and the null hypothesis was rejected. Results from a chi-square test indicated that fewer students were college eligible in the postpolicy cohort; again, the null hypothesis was rejected. The positive social change intent of those making the policy change was laudable yet increasing course requirements for graduation alone did not serve as a mechanism to improve college and career readiness. Increasing student performance in a college preparatory curriculum might require additional supports such as improved instruction, increased intervention, and expanded access to college advisement to build college knowledge. Further research is needed to understand how policy changes influence student outcomes such as college access, persistence, and completion.

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Chapter 1: Introduction to the Study

The research problem for this study was the uncertain influence of a local curricular policy change on college readiness of high school graduates from a selected district. Educators, policymakers, and communities need more data to determine the usefulness of a change in policy and practice because the changes involve restructuring, resource allocation, and understanding what might be the intended and unintended consequences of policy implementation. Positive social change implications might include additional information on how implementing policy changes involving curricula serve students moving from high school to the postsecondary level.

In this chapter, I provide an introductory background of the study and a brief introduction to the research literature. I include an overview of the education issue, the gap in practice, and the research problem. I introduce the study purpose and aspects of the study design including research questions and variables, as well as the theoretical framework and any assumptions and limitations of the study. More details related to these elements are addressed in the remaining chapters.

Background

The education issue that led to this study is the lack of college readiness among high school graduates. In the United States, high school graduation rates have increased 6% since 2011 to 85% with more than 3.5 million students currently earning a high school diploma (Atwell et al., 2019). However, the national rise in high school graduation rates has not included a rise in college enrollment. Many students across the United

States meet all the requirements to earn a diploma yet are ineligible for college as they have not completed the courses necessary to enter public state universities.

Education reform efforts across the nation have been focused on increasing college readiness with much attention given to the development and implementation of the Common Core Standards and standardized assessments that align with college expectations. While most states have adopted the Common Core Standards and either the Smarter Balanced Assessment Consortium or Partnership for Assessment of Readiness for College and Careers (Common Core State Standards Initiative, 2019), little attention has been given to the lack of alignment between the requirements for high school graduation and the minimal course requirements for state 4-year public universities (Jimenez & Sargrad, 2018).

The National Student Clearinghouse Research Center (2018) reported that 2-year and 4-year college enrollment rates have declined over 1% each year since 2011, with an overall decrease of 10%, moving from a 20,556,272-student enrollment in fall 2011 to a 18,484,391-student enrollment in fall 2018. As of 2015, only 36% of students nationally complete bachelor's degrees within 6 years (Ryan & Bauman, 2016). More jobs are requiring postsecondary degrees (Carnevale et al., 2016). At the current rate of degree attainment, states like California will be short over a million college educated workers by 2030 (California Competes, 2015; Johnson et al., 2015), creating a threat to the state's and nation's ability to thrive in a global economy.

Education leaders in several school districts in the United States have increased the high school graduation course requirements to include specific college-preparatory

courses required for admission into the 4-year public state university system (Buddin & Croft, 2014; Gao, 2016). The impetus for the local policy change was to increase college readiness by mandating that students complete the college preparatory courses, thereby increasing student access to public state universities (Buddin & Croft, 2014; Gao, 2016; Garcia et al., 2015; Phillips et al., 2015). This issue of college readiness is urgent at a national level as well because 50% of the students in the United States do not complete the high school courses necessary to meet 4-year public state university admissions requirements (Bromberg & Theokas, 2016). This lack of eligibility has contributed to consistent declines in college enrollment (National Student Clearinghouse Research Center, 2018) and low rates of college graduation (Ryan & Bauman, 2016). Based on previous research evidence for a positive relation between course rigor and college readiness (Bryan et al., 2015; Byun et al., 2014; Conley et al., 2014; Jha & Stearns, 2018; Means et al., 2016; Morgan et al., 2018; Royster et al., 2015; Woods et al., 2018), many states have increased their high school course rigor or aligned their curricula to the 4-year public state university requirements in order to increase college readiness (Jimenez & Sargrad, 2018).

These national policy trends influenced similar policy adoptions by select school districts to combat their growing crises of college ineligibility (Buddin & Croft, 2014; Gao, 2016). However, relatively little is known about the efficacy of school districts increasing high school course requirements to improve college readiness (Buddin & Croft, 2014; Plunk et al., 2014; Preston et al., 2017). There is a pattern of mixed evidence of both positive and negative outcomes across a variety of college readiness measures

(Buddin & Croft, 2014; Plunk et al., 2014; Preston et al., 2017), including conflicting patterns of increased high school GPA (Le et al., 2016), decreased high school GPA (Allensworth et al., 2009; Montgomery & Allensworth, 2010; Preston et al., 2017), or no change (Betts et al., 2016). The gap in practice is that these new reform policies for increasing course requirements are being widely implemented across the nation despite the uncertainty and mixed results regarding the efficacy of such programs for specifically improving students' college readiness as measured by GPA. Bromberg and Theokas (2016) reported that in the United States almost 47% of high school graduates do not complete eligibility requirements for public state colleges. School personnel across the country have addressed this issue by changing high school graduation requirements, changing curricular designs and requirements, and increasing college preparatory programming. The ways in which the approaches are implemented and in how outcomes are evaluated have been as varied as the policy changes. Researchers have shown that rigor of high school curricula relates to college enrollment, persistence, and completion (Ackerman et al., 2013; Bryan et al., 2015; Byun et al., 2014; Conley, 2007; Conley et al., 2014; Jha & Stearns, 2018; Means et al., 2016; Morgan et al., 2018; Royster et al., 2015; Woods et al., 2018).

Problem Statement

The research problem addressed in this study was the uncertain influence of a local policy change on potential changes in college readiness of high school graduates from a selected district. The district has been identified as an example of the changes in curricular policy being attempted in the state and across the United States. Educators,

policymakers, and communities need more data to determine the usefulness of a change in policy and practice because the changes involve restructuring, resource allocation, and understanding what might be the intended and unintended consequences of policy implementation. The policy change in the western state where I conducted the study was made to require all high school students to complete a set of college preparatory courses in order to be eligible for entrance into 4-year public state universities. My goal was to understand whether a change in curricula that requires the college preparatory program for all students led to increased college readiness and therefore increased eligibility for higher education.

Purpose of the Study

The purpose of this ex post facto study was to investigate how a change in local curricular policy might have influenced high school graduates' college readiness as measured by high school GPA. Colleges have used high school GPA as one of the primary predictors of academic performance for many decades (Westrick et al., 2015). High school GPA is one of the most widely used indicators of college readiness and reflects Conley's Keys 1-3 (Conley, 2007). Conley (2014) proposed that high school GPA is one of the strongest predictors of college success. Scholars have found that high school GPA more highly correlates with postsecondary student performance than college entrance exams such as the American College Test (ACT; Hiss & Franks, 2014; Hodara & Cox, 2016; Hodara & Lewis, 2017; Westrick et al., 2015). Numerous previous quantitative research studies have also used high school GPAs for assessing college

readiness and new graduation policies (Betts et al., 2016; Le et al., 2016; Preston et al., 2017).

Research Question and Hypotheses

RQ1: How do high school GPA scores differ before and after implementation of a local curricular policy change?

$H_0$1: There is no statistically significant difference in the high school GPA scores before and after the implementation of a local curricular policy change.

H_a1: There is a statistically significant difference in the high school GPA scores before and after the implementation of a local curricular policy change.

RQ2: How does college eligibility differ before and after the policy change, as measured by the number of high school students who graduated with a GPA of 3.0 or higher (minimum eligibility for the state's advanced 4-year universities), with a GPA between 2.0 and 2.99 (minimum eligibility for the state's standard 4-year universities), or with a GPA below 2.0 (not eligible for a state 4-year university)?

$H_0$2: There is no statistically significant difference in the college eligibility before and after the policy change, as measured by the number of high school students who graduated with a GPA of 3.0 or higher (minimum eligibility for the state's advanced 4-year universities), with a GPA between 2.0 and 2.99 (minimum eligibility for the state's standard 4-year universities), or with a GPA below 2.0 (not eligible for a state 4-year university).

H_a2: There is a statistically significant difference in the college eligibility before and after the policy change, as measured by the number of high school students who graduated with a GPA of 3.0 or higher (minimum eligibility for the state's advanced 4-year universities), with a GPA between 2.0 and 2.99 (minimum eligibility for the state's standard 4-year universities), or with a GPA below 2.0 (not eligible for a state 4-year university).

Theoretical Foundation

I have grounded this quantitative study in Conley's theoretical framework focused on the multifaceted concept of college readiness (Conley, 2014; Conley, 2017). I used this framework because it encompasses the academic factors that students need to enroll in college (Conley, 2014). At the heart of Conley's work is the need to complete a college preparatory curriculum such as the courses mandated by the new local graduation policy. Conley (2014) identified four major domains of readiness called the "Four Keys to College and Career Readiness," which include a student's cognitive thinking ability, content knowledge, academic behaviors, and ability to transition into postsecondary institutions. Conley (2014) recommended using high school GPA as an indicator variable of college readiness because it aligns well with the aforementioned student characteristics and "is the strongest predictor of postsecondary success" (p. 14). In Conley's framework, the domain of cognitive ability (Key 1: "think") includes the important critical thinking capacity of a student preparing to engage in rigorous college level courses: critical analysis of text or lectures, sophisticated organization of content and work output, problem-solving skills, and the use of the scientific method. The domain of knowledge

(Key 2: “know”) includes the totality of student content knowledge gained in a college preparatory curriculum: studies in the core subjects of math, English language arts, history, arts, science, and foreign language. The domain of learning skills (Key 3: “act”) or student conduct within the learning process includes the ability to persist, becoming meta-aware of personal abilities or progress towards enhancing personal learning processes, and study and time management skills related to learning. The domain of college mindset and transition (Key 4: “go”) involves knowing how to look for and apply to college, how to evaluate or decide between colleges for the best match and fit, planning classes in high school to better prepare, understanding how to navigate financial aid options, understanding expectations, and developing agency in order to advocate for themselves to get what they need. These four keys encompass multiple components of what it means to be college ready, thereby requiring multiple measures of college readiness to sufficiently understand it (Conley, 2017). Conley’s recommendations, as well as other researchers’ guidelines and definitions of college readiness (ACT, 2013; Bryan et al., 2015; College Board, 2010; Perusse et al., 2015), have influenced the selection of the dependent variable of high school GPA, an indicator of college readiness, for this current study.

Nature of the Study

A quantitative methodology was the most appropriate choice for this study because the purpose of this study was to understand how a new policy influences potential changes in student college readiness as measured by high school GPA. Because understanding the potential influence of such policy on high school GPA requires

comparing GPA before and after policy implementation, I used quantitative methods to statistically test the change in high school GPA. I specifically chose an ex post facto research design because it has been identified as an appropriate quasi-experimental design for analyzing already existing data after potential cause-effect relations have already occurred, and therefore the experimenter cannot manipulate the independent variable (Vogt, 2005). An alternatively similar design for the purpose of this study could have been a causal comparative design, used to compare the potential effect of an independent variable on dependent variables without experimental manipulation (Busk, 2017). However, this design seemed less appropriate for this study because it is used to make stronger claims about the causal relation, which I could not have reliably concluded without being able to control for possible confounding variables, such as other changes of student or school factors not related to the policy change. Controlling for such confounds would have required more complicated statistical analyses such as multiple regression or propensity score matching used by previous causal comparative studies to test influences of policy change on college readiness (Byun et al., 2014; Long et al., 2012).

I operationalized the new policy as an independent variable called cohort with two levels: the prepolicy class of 2013, 2014, and 2015 graduates, before the policy was implemented, and the postpolicy class of 2016, 2017 and 2018 graduates, the first graduating cohorts affected by the new graduation policy. I examined the influence of the curricular change policy on student high school GPA, an indicator of college readiness, by comparing the students' GPA between these "before" and "after" policy implementation cohorts, using an independent samples *t* test. This is a well-validated

procedure that has been used in several previous quantitative studies that have investigated the connection between policy changes mandating the completion of more rigorous courses and college readiness as measured by student high school GPA (Betts et al., 2013; Betts et al., 2016; Domina et al., 2015; Kim et al., 2015; Le et al., 2016; Long et al., 2012; Plunk et al., 2014). I investigated how a local graduation policy mandating the completion of college preparatory courses potentially influenced student college readiness as measured by student high school GPA within a selected district.

In order to investigate any differences before and after the policy change in college eligibility, I investigated the number of students eligible for state 4-year universities. I conducted a chi-square test of independence to determine the number of students not eligible for 4-year state universities with below a 2.0 GPA, the number of students eligible for the state's standard university system with a minimum GPA requirement of a 2.0, and the number of students eligible for the state's advanced university system with a minimum GPA requirement of a 3.0.

Operationalized Term Definitions

Cohort: For this study, the independent variable is called "cohort" and reflects the new graduation policy with two levels of "prepolicy" graduates (Classes of 2013-2015) and "postpolicy" graduates (classes of 2016-2018).

College readiness: The academic and nonacademic characteristics that indicate a student has the knowledge and skills to be successful in college entry level courses to a level where they can persist in their field of study at a 2-year or 4-year institution.

High school grade point average (GPA): For this study, the dependent variable is called high school GPA and reflects college readiness similar to previous research studies. High school GPA was defined for each student on a continuous scale from 0 to 4, which is calculated as an average across all high school years of classes, not just the senior year. High school GPA is defined in exactly the same way for both prepolicy and postpolicy graduate groups.

Scope and Delimitations

College readiness was the specific focus of this study's research problem and purpose because a lack of college readiness in high school graduates continues to be a major concern in the educational system of the United States across many states and local districts. The study sample included data from students who had already graduated from a local district of interest for the primary reason that their full data was accessible in the database for analysis, and also because the identified issue of practice concerns high school graduates who are ineligible for college. It is important to note, therefore, that these study findings may only be generalized to other high school graduates rather than to all currently enrolled students. However, a reasonable implication is that such enrolled students will soon be graduates and face the same challenges as the current study's sample of interest. I chose high school GPA as the specific variable to operationalize or represent college readiness because it is widely used in the research and theoretical literature as an important indicator variable of college readiness. However, this means that I can only generalize this study's findings to college readiness as measured by high school GPA instead of other important measures of college readiness such as college

enrollment, college persistence, and college completion. I grounded this study in Conley's (2014, 2017) theoretical framework of college readiness because it is widely used and directly relevant to the study topic, the research problem, and the chosen dependent variable of high school GPA as an indicator of college readiness. Other theoretical frameworks such as Bandura's (2017) social learning theory or Eccles' expectancy-value theory (Lauermann et al., 2017) are relevant for understanding how students learn and achieve their educational goals but are less directly important for understanding the specific phenomenon of college readiness.

Limitations

One potential limitation related to construct validity was the use of only one measure, high school GPA, to reflect the complex and multidimensional concept of college readiness. However, many other research studies on this topic have also used GPA as a single measure of college readiness because it is well grounded in theoretical and conceptual frameworks of college readiness, and so this chosen design was well justified. Another potential limitation was that this study sample included only high school graduates who were not students with disabilities because some of those candidates have modifications and accommodations within the required curriculum. Therefore, the study findings will not generalize to such populations who were excluded here. Another potential limitation was the possible violation of assumptions of homogeneity and independence that are inherent to the chosen analytical method of an independent samples *t* test. However, careful statistical procedures were used to ensure no such violations of assumptions occurred. A more in-depth discussion of this study's

potential limitations can be found in the Threats to Validity section in Chapter 3. Another potential limitation was that, in order to optimize the simplicity of the study design, I did not control for additional variables such as student demographics or student aspirations that could potentially confound the relation between the policy change and student outcomes of college readiness. Finally, because the current study was based on a quasi-experimental design, I was not able to experimentally manipulate the independent variable. Therefore, I cannot conclude any cause-effect relations between policy change and college readiness outcomes, although it is possible to conclude that the observed results were at least consistent with a potential cause-effect relation.

Significance

Findings from this study have potential implications for positive social change in increasing educational outcomes and improving subsequent career and financial opportunities in present and future students at the local site of the study as well as across the nation for all those students for whom these results would generalize. Such positive change would also help to boost local and global economies due to an increase in college-educated workforce. It is important to investigate district policy change efforts given that national and local education improvement efforts are focused on improving college readiness (Malin et al., 2017). Many school districts across the nation have changed their graduation policies by increasing course requirements or mandating the completion of a college preparatory curriculum, aligning the high school diploma requirements with the minimum courses required for admission into the 4-year public state university system, with mixed results. Currently, the largest public university system in the United States is

attempting to increase college readiness by adding additional course admissions requirements (Anderson, 2019; Lee, 2019; Samuels, 2019). Researchers have long known that college graduates do better economically, with higher wages, and socially, in terms of community engagement overall, when compared to their non-college-going peers (Hull, 2015). However, researchers have also found that noncollege goers also experienced long-term benefits in the labor market if they completed rigorous high school courses with an above average GPA (Hull & Dillon, 2016).

The current study has several potential implications for positive social change in educational practice and reform. The results are relevant to an audience including state and district policymakers concerned with high schools and subsequent college outcomes (Gao, 2016). The results may also be of interest to other school districts across the nation considering increasing graduation course requirements as a possible strategy to increase the number of students graduating college ready (Buddin & Croft, 2014; Plunk et al., 2014; Preston et al., 2017). The findings from this study may also be informative to high school education policy reform efforts. As a result of completing college preparatory courses, students will have increased access to postsecondary education opportunities and greater economic opportunities and mobility out of poverty (Hull & Dillon, 2016), which are ideals that are part of the American dream. Being aware of how increasing courses required in graduation policies relate to college readiness is essential for policy makers, administrators, and educators to better serve and assist students who represent the future American workforce.

Summary

In this study, I addressed the research problem of the uncertain influence of a local curricular policy change on potential changes in college readiness. The underlying issue of inadequate college readiness in high school graduates may be due to the misalignment between high school and college-level curricula, leaving high school graduates ineligible for 4-year public state universities. It is a significant issue because there continues to be regional and national epidemics of low rates of college readiness and enrollment which threatens local and global economies through a deficit in college-educated workforce. The purpose of the study was to investigate how a change in local curricular policy may or may not have influenced high school graduates' college readiness, as measured by high school GPA. It is important to understand this potential link between policy and practice because such graduation course requirements are becoming increasingly popular across numerous local and state high schools and districts despite insufficient research on the topic as well as much contradictory evidence in the available research of positive, neutral, or negative outcomes of college readiness from such policy implementation. The current study investigated these issues within a large sample of data from students graduating either before or after a local high school district implemented the mandatory graduation course requirements. I compared the high school GPA, the chosen indicator of college readiness, of these students before and after policy adoption by using an independent samples *t* test and then compared differences in college eligibility using a chi-square test of independence. In Chapter 2, I present the literature review and support for the framework and the chosen variables.

Chapter 2: Literature Review

The research problem addressed in this study was the uncertain influence of a local curricular policy change on potential changes in college readiness. The purpose of this ex post facto study was to investigate how a change in local curricular policy may or may not have influenced high school graduates' college readiness as measured by high school GPA. I conducted a review of the literature to understand the connection between states and school districts increasing high school course requirements and college readiness as evidenced by student enrollment and persistence in postsecondary education programs. I have noted throughout this review the different interpretations of college readiness and how relatively little is known about the efficacy of increasing course requirements as an intervention to increase college entrance with mixed evidence of positive and negative results. Researchers have emphasized the importance of students' successful participation in academically rigorous courses as an indicator of college readiness. To determine whether a change in high school graduation policy affected college readiness, it is important to understand the multiple dimensions that make up the definition of college readiness and how the indicators are used to determine readiness.

I used one measure of college readiness as a dependent variable in the analysis: student high school GPA. I chose this variable because of consensus in the literature regarding the strength and importance of GPA as an indicator of college readiness (ACT, 2013; Bryan et al., 2015; Conley, 2014; College Board, 2010; Perusse et al., 2015). In the following sections, I present a literature review of high school GPA as a college readiness indicator and how it has been used by researchers as a dependent variable influenced by

implementations of high school graduation policies that increase rigorous coursework, like the new policy courses investigated by the current study. There have been numerous quantitative studies published in the educational research literature in the last several years that have been conducted by researchers in order to address the impact of policies mandating the completion of more rigorous courses for high school graduation on college readiness indicators, such as high school GPA.

Literature Search Strategy

I conducted the literature search using the Google and Google Scholar search engines as well as the ERIC and SAGE databases in the Walden library. I used the following keywords interchangeably or in combination depending on the need for different subtopics of the research: *college readiness, improving college readiness, high school, GPA or grade point average, academic performance, college aspirations, college enrollment, college persistence, graduation requirements, increasing graduation requirements, course requirements, increasing course requirements, curriculum, A-G courses, A-G course sequence, education reform effects education policy, Common Core, effects, theory, theoretical framework, Conley's theory, quantitative design and methodology, quasi-experimental methodology,* and *ex post facto*.

For every keyword I conducted a first pass search without specifying a minimum year of publication to include seminal publications that predate the 5-year maximum age of the publications because seminal works are often essential to understanding a topic. I conducted a second pass specifying a 5-year minimum using the advanced search option indicating a range of 2013 to current. Of these 5-year minimum articles, I included only

those published in 2014 or later. For any keyword entered, I assessed and recorded articles from the first three to 20 pages of Google results. I conducted this procedure in five steps. For Step 1, I read the title to determine relevance. For Step 2, I read the abstract to determine relevance to the research subtopic. For Step 3, I read or skimmed the article to determine relevance. For Step 4, I paraphrased important sentences or paragraphs from the article for use in relevant subsections of the study, along with the full APA reference for that article. For Step 5, I investigated relevant sources cited in the article and applied the same five-step procedure. I discovered many of the reviewed sources from Step 5 because many relevant articles included citations to other relevant articles. I included only peer-reviewed journal articles in the literature review. However, I also included many nonjournal articles in the five-step procedure to learn information not provided in the journal articles.

Theoretical Foundation and Framework

I framed this quantitative study using Conley's (2014, 2017) concept of college readiness. Conley (2014) designed this framework to encompass both academic and nonacademic factors that influence students' readiness to succeed in a postsecondary program of study. Conley (2014) defined *college readiness* as a student possessing "the content knowledge, strategies, skills, and techniques necessary to be successful in any of a range of postsecondary setting" (p. 15), where success is defined by the students' ability to progress onto the second year of college in their field of study. Conley's (2014) notion of college readiness also includes completion of a college preparatory curriculum, such as the courses mandated by the new graduation policy at the study site. Conley (2014)

identified four major domains of readiness called the "Four Keys to College and Career Readiness," which include a student's cognitive thinking ability, content knowledge, academic behaviors, and ability to transition and succeed in more rigorous coursework of postsecondary institutions. These four keys encompass multiple components of what it means to be college ready (Conley, 2017).

The domain of cognitive ability (Key 1: "think") includes the important critical thinking capacity of a student preparing to engage in rigorous college level courses: critical analysis of text or lectures, sophisticated organization of content and work output, problem-solving skills, and the use of the scientific method.

The domain of knowledge (Key 2: "know") includes the totality of student content knowledge gained in a college preparatory curriculum: studies in the core subjects of math, English language arts, history, arts, science, and foreign language.

The domain of academic behaviors (Key 3: "act") or student conduct in the learning process includes the ability to persist, becoming meta-aware of personal abilities or progress towards enhancing personal learning processes, and more study and time management skills related to learning.

The domain of college mindset and transition (Key 4: "go") involves knowing how to look for and apply to college, how to evaluate or decide between colleges for the best match and fit, planning one's classes in high school to better prepare, understanding how to navigate financial aid options, understanding students' own academic expectations, and developing agency in order to advocate for themselves to get what they need.

This study's chosen dependent variable of high school GPA as a measure of college readiness aligns with Conley's framework in the following ways. Student high school GPA was selected as the indicator of college readiness because it aligns with Conley's operational definition of college readiness and reflects three of the four keys in the theoretical framework. High school GPA is one of the most widely used indicators of college readiness and reflects Conley's Keys 1-3, content knowledge, academic performance, and also "a whole series of meta-cognitive learning skills such as time management, study skills, help-seeking strategies, persistence, and goal focus" (Conley, 2014, p. 14). High school GPA is one of the criteria used for admittance into the 4-year public state university systems and is also recommended by the National Office of School Counselor Advocacy (NOSCA) as the performance aspect of academic preparation (Perusse et al., 2015) and by others as part of academic factors (Bryan et al., 2015; Hatch, 2013; Nagaoka et al., 2013). High school GPA has also been widely used by previous studies in assessing college readiness and new graduation policies (Betts et al., 2016; Le et al., 2016; Preston et al., 2017). Conley's recommendations, as well as other researchers' guidelines and definitions of college readiness, which include high school GPA as an important measure (ACT, 2013; Bryan et al., 2015; College Board, 2010; Perusse et al., 2015), have therefore influenced the selection of the indicator variable used in this study.

Literature Review Related to Key Variables

College Readiness

The concept of college readiness has been the subject of debate with researchers regarding dimensions and indicators. College readiness is a complex concept with multiple dimensions, making a consistent definition difficult to obtain. Conley (2003) discussed the difficulties in producing a universal definition of college readiness. Jackson and Kurlaender (2014) also emphasized the difficulties in defining college readiness and referred to it as a "nebulous term" (p. 955). Colleges and universities conventionally define college readiness according to the courses taken in high school, achievement marks received, and performance on college readiness examinations such as the Scholastic Aptitude Test (SAT) and/or ACT. However, universities and colleges such as Harvard University and Sonoma State University have varied benchmarks of performance making defining college readiness difficult. The California State University (2017) system defined college readiness as the ability to complete college-level, credit-bearing mathematics and English courses that count toward completing a baccalaureate degree. Several definitions of college readiness appear in the literature, and I considered these definitions when defining college readiness in the current study.

State Definitions of College Readiness

More than half of U.S. states (33) have adopted a definition of college readiness (Webster, 2015). There are several common elements among the state definitions, including knowledge of core academic subjects, the ability to problem-solve and think critically, the ability to collaborate and communicate with others, the capacity to persist

and bounce back from adversity, and the development of responsible citizenship and a social conscience (Mishkind, 2014; Webster, 2015). The most common component is the acquisition and mastery of knowledge in core academic subjects, embraced by 19 of the 33 states (Mishkind, 2014; Webster, 2015). Most states have adopted college readiness standards for English and math, and they have required students to take high school assessments to measure student proficiency (Webster, 2015; WestEd, 2016). Less common requirements, such as the ability to use technology, are seen in Maryland and Oregon; Hawaii, Massachusetts, and West Virginia include the capacity to develop into lifelong learners; and Hawaii emphasizes being environmentally conscious (Mishkind, 2014). The varying state definitions indicate some of the complexities with defining college readiness.

Factors Included in the Definitions of College Readiness

Education organizations, researchers, and scholars include a multitude of factors in their definitions of college readiness. NOSCA describes a set of eight key components for defining college readiness: (a) college aspirations, (b) academic planning that includes rigorous courses and performance, (c) extracurricular activities, (d) exploration and selection of college and careers, (e) performance on college assessments, (f) financial planning, (g) admission process, and (h) college enrollment (College Board, 2010; Perusse et al., 2015). Similar to the NOSCA components, Bryan et al. (2015) and Hatch (2013) defined college readiness as encompassing the following factors: high school GPA of at least 3.0 rigorous course taking, meeting state benchmarks for reading and math, taking the SAT or ACT, involvement in extracurricular activities and community

service, having educational and career aspirations, knowledge of the college application process, college enrollment, application for financial aid, and ability to request transcripts and test scores. Nagaoka et al. (2013) discussed the crucial distinction between academic factors of college preparation such as high school GPA, grades, SAT, and advanced coursework and noncognitive factors of academic mindset and attitudes, study strategies, and skills. Nagaoka et al. (2013) also discussed the importance of both factors as predictors of academic success. A common component throughout the various definitions is providing a rigorous high school curriculum so that students may increase their content knowledge, learning skills, their eligibility for colleges and universities, and their ability to transition and succeed in the more rigorous coursework of postsecondary institutions.

Rigorous High School Curriculum & Noncognitive Skill Development

Conley (2007) connected the participation in a rigorous high school curriculum with the development of non-cognitive skill sets. During the Understanding College Success project, Conley (2003) surveyed faculty from 20 different universities on the knowledge and skills necessary to participate and pass a college level course. Based on these findings, Conley (2003) identified key content knowledge in the various content areas of English, math, science, history, second language, and the arts. Conley (2003) also included non-academic skill sets essential for success such as time management, note taking, writing, problem solving, critical thinking, persistence, grit, and communication skills (Conley, 2003). The professors viewed the non-cognitive strategies and skills as equally important as the content knowledge and skills (Conley, 2003). These findings were used to develop the college readiness standards. Later, Conley (2007)

expanded on the college readiness standards by creating a college readiness model that integrates the multiple skill sets that include both cognitive and non-cognitive factors, providing a holistic interpretation of college readiness. While cognitive skills are at the center of Conley's (2007) model, they are intertwined with non-cognitive behaviors and skills. In order to obtain mastery of academic content areas, students must also develop the non-cognitive skills necessary for success; however, Conley (2007) made a clear distinction between academic knowledge and academic skills. Academic knowledge is specific to understanding of key ideas and concepts within a specific discipline, while academic skills of critical thinking, analyzing, problem solving, writing, communication, time management, persistence, and grit are relevant across all content areas (Conley, 2007). Conley (2014) defined *college readiness* as a student possessing "the content knowledge, strategies, skills, and techniques necessary to be successful in any of a range of postsecondary setting" (p. 15), where success is defined by the students' ability to progress onto the second year of college in their field of study. Conley's theoretical framework of college readiness has been the grounding framework for a variety of educational research studies (Conley, 2014).

Conley's Definition of College Readiness

Conley (2018) defined college readiness as a multifaceted concept encompassing features of the student's knowledge and skills in terms of academic preparation, such as traditional metrics of grades, high school GPA, college preparatory courses, and non-academic preparation such as skills, ability to learn, think, and reason. Conley (2014) identified four major domains of readiness called the 'Four Keys to College and Career

Readiness' which include a student's cognitive and thinking ability, knowledge, learning skills, and mindset and preparation for transition to college. The domain of cognitive ability (Key 1: "think") includes the important thinking capacity of a student preparing to engage in complex ways of thinking: critical analysis of text or lectures, sophisticated organization of content and work output, problem-solving skills, and the use of the scientific method. The domain of knowledge (Key 2: "know") includes the totality of student knowledge: preparatory studies in the core subjects of math, English language arts, history, arts, science, and foreign language. The domain of learning skills (Key 3: "act") or student behavior within the learning process includes the ability to persist, becoming meta-aware of personal abilities or progress towards enhancing personal learning processes, and more specific study and time management skills related to learning. The domain of college mindset and transition (Key 4: "go") involves knowing how to look for and apply to college, how to evaluate or decide between colleges for the best match and fit, planning one's classes in high school to better prepare, understanding how to navigate financial aid options, understanding expectations, and developing agency in order to advocate for themselves to get what they need.

How Other Definitions Align with Conley's Keys

Conley's (2014) four keys of college readiness incorporate many of the factors emphasized by educational organizations, researchers, and scholars in their definitions of college readiness. Completing a rigorous curriculum is acknowledged by both educational organizations and scholars as a critically important indicator and determining factor of college readiness in high school students (Bryan et al., 2015; College Board,

2010; Hatch, 2013; Nagaoka et al., 2013; Perusse et al., 2016). There is consensus among researchers that college readiness is one of the principle factors that influences college entrance, college persistence, and degree completion. However, as I discuss in the next section, scholars and researchers differ on the indicators that designate college readiness.

Traditional Measures Used by Colleges to Determine Readiness

The traditional measures of college readiness set by college and university admissions offices are typically the types of courses completed, high school GPA, exam scores on college entrance tests such as the ACT or SAT, and course placement tests (Douglass, 2007). The state 4-year public universities use one or more of the following indicators of college readiness specific to math and English: a high score on the SAT (e.g., above a 550 for math and a 500 for English); a high score on the ACT (e.g., a score above a 23 in math and a 22 in English); an Advanced Placement score of a 3 or higher in a relevant English or math course; obtaining a grade of a C or higher from a community college course in English or math; scoring at the "standard exceeded" level on the Early Assessment Program test; or scoring above a 50 in math and above a 147 in English on college placement exam (California State University, 2017). Because one of the indicators of the quality of a university is their graduation rate (Fain, 2018), universities' selection process attempts to identify qualified students who will successfully complete degrees. However, according to Conley (2012), these tests provide a narrow and inaccurate assessment of college readiness as they do not consider other non-cognitive factors such as student interest and aspirations. This is evidenced by the fact that one third of college freshman must take at least one remedial English or math course (Ling &

Radunzel, 2017) and less than 23% of students complete a college degree nationwide (Linderman & Kolenovic, 2013). A better predictor of college readiness is student high school GPA which researchers have found to be more highly correlated with student performance than the ACT, a traditional college entrance exam (Hiss & Franks, 2014; Hodara & Cox, 2016; Hodara, & Lewis, 2017; Westrick et al., 2015).

Student high school GPA in a college preparatory curriculum has been recognized by several researchers as the strongest predictor of college success (Allensworth & Clark, 2019; Balfanz et al., 2016; Conley, 2014; Fonteyne et al., 2017; Giersch, 2018; Koretz & Langi, 2018; McNeish et al., 2015; Morgan et al., 2018; Sanchez & Mattern, 2018; Sanchez et al., 2018; Westrick et al., 2015; Williams et al., 2018). High school GPA is one of the strongest indicators of college readiness and is grounded in Conley's (2014) Keys 1-3 as it reflects content knowledge, academic performance, and "a whole series of meta-cognitive learning skills such as time management, study skills, help-seeking strategies, persistence, and goal focus" (p. 14). Other scholars have also discussed high school GPA as reflecting both academic and nonacademic factors of student learning (ACT, 2013; Conley, 2014; Westrick et al., 2017). Like Conley (2014), Mattern et al. (2014) explained that high school GPA not only reflects student academic achievement but also reveals non-cognitive aspects of study habits, organization, self-regulation, grit, and motivation that play an integral role in college readiness and postsecondary success. There is a consensus in the experimental and theoretical literature regarding the importance and usefulness of high school GPA as an indicator of college readiness with

which to assess the potential influence of new curricular or graduation policies (Bryan et al., 2015; Conley, 2017; Perusse et al., 2015).

Disconnect between High School and College Curriculum

Conley (2014) highlighted a disconnect between high school and college curriculum as one of the barriers to college readiness and he emphasized the need to align secondary curriculum and instruction with college expectations. Students who met the admissions criteria with advanced course completion, high school GPA, and scores from college entrance exams were struggling in college courses and not persisting. The non-cognitive skills and strategies identified by professors during the *Understanding College Readiness* project (such as problem solving, thinking critically, analyzing, persistence, and grit) did not reflect the knowledge, skills, and strategies developed by students and were missing from high school courses (Conley, 2003). For example, Conley (2007) noted that newly enrolled college students did not know how to respond to resources that gave conflicting perspectives on a single event. Students wanted to know which version was correct rather than critically analyzing the resources. Legislatures in states such as Florida, Massachusetts, New York, Oklahoma, Oregon, Rhode Island, and Virginia have made efforts to align curricular standards and to use high school exit exams for assessing college readiness (Perna & Armijo, 2014). However, colleges and universities do not consider the exit exam scores in their admission processes (McIntosh, 2012). In the 1990s, some states like Idaho, Massachusetts, Pennsylvania, South Dakota, and Virginia have appointed secretaries of education with the oversight responsibilities of pre-school through postsecondary education without success (Kirst & Usdan, 2009; Van de Water &

Rainwater, 2001). The disconnect between high school and college was recognized nationally and spurred the development of the Common Core Standards by the National Governors Association and Council of Chief State School Officers. The adoption of the Common Core Standards in 45 states began the alignment of high school and college knowledge, skills, and expectations. Also, since 2004, 36 of the 50 states have increased their high school course requirements for graduation (Achieve, 2015).

Graduation Course Requirements in United States

Having rigorous standards means little if students are not mandated to complete the advanced courses associated with college readiness as part of high school graduation requirements. The courses required for a high school diploma matter as they can ensure students are eligible for postsecondary success or they can impede the opportunities and choices available to graduates. Although 23 states have increased the course requirements for high school graduation, many allow students to opt out of advanced math and science courses with parental consent while still receiving the same diploma (Achieve, 2015). A review of high school course requirements in all fifty states by Jimenez and Sargrad (2018) from the Center for American Progress found that high school requirements for most states do not align with the course admissions requirements for their respective 4-year state public university systems. This means that students can earn a high school diploma but not meet the minimum course requirements for entry into their state's 4-year public university system, thereby impeding their postsecondary options and opportunities. The lack of alignment sets up gaps in access, as the researchers found that required high school courses for university admission were not necessarily offered in

every high school (Jimenez & Sargrad, 2018). More than half of the states (27) do not require a college preparatory curriculum as part of their high school graduation requirements, leaving the decision to take advanced courses up to individual students if the courses are provided in their district and high school (Achieve, 2015). For example, between 10% - 25% of states do not offer Algebra II, biology, or chemistry, while less than 50% of high school offer calculus (U.S. Department of Education, 2014). A longitudinal study by Bromberg and Theokas (2016) of a nationally representative group of student course completion from 2009 through 2013 found that only 31% of the sample of 23,000 students completed a college preparatory curriculum. A study by the Center on Standards Assessment and Implementation (CSAI) at WestEd (2016) found that more than half the states, including California, do not require college preparatory course of study as part of their graduation requirements. The misalignment of curriculum contributes to students' lack of college readiness regardless of whether they earned a high school diploma.

Rigorous Courses that Align with College Readiness

Scholars have found that the successful completion of specific rigorous high school courses are associated with a college preparatory curriculum and college readiness. Many scholars identify the completion of at least three years of mathematics that include Algebra II and four years of English Language Arts (Achieve, 2015; Bromberg & Theokas, 2016; WestEd, 2016). However, the Center of Standards and Assessment Implementation at WestEd (2016) also included three years of science and history and two years of a Language Other Than English (LOTE). The Center of

Standards and Assessment Implementation (CSAI) place a caveat for students to take two years of LOTE or two years of a career technical education (CTE) course. The 4-year public state university system has identified a set of new courses to ensure college readiness and to ensure that students have the necessary preparation, breadth of knowledge, and skills to participate and pass in college level courses. The new courses span seven content areas, each with a minimum time requirement: two years of history/social science (“a”); four years of English (“b”); three years of mathematics (“c”); two years of laboratory science (“d”); two years foreign language (“e”); one year of a visual and performing arts (“f”); and one year of a college preparatory elective (“g”). In addition to course requirements, many high schools provide opportunities for Advanced Placement (AP), International Baccalaureate (IB), and dual enrollment courses in order provide students the opportunity to gain college credits, develop skills necessary for postsecondary success, and to gain familiarity with the rigor and expectations of college level coursework. Research studies have found a significant positive correlation between the successful completion of AP or IB courses and academic achievement in college (Ackerman et al., 2013; Conley et al., 2014; Morgan et al., 2018). While educators, policymakers, researchers, and practitioners might identify different sets of courses to determine college readiness, all would agree that the objective of a college preparatory curriculum is to ensure that students are prepared to enroll and succeed in college-level, credit-bearing courses without the need for remediation.

Increasing Course Requirements

School districts and states have made concentrated efforts to increase the number of students taking more rigorous courses in order to better prepare students for postsecondary success (Byun et al., 2014). Long et al. (2012) investigated the effects of taking more rigorous courses on college readiness in an exceptionally large sample (N > 100,000) of 9th and 10th grades across Florida school districts. The researchers minimized the confound of selection bias (i.e., students who take more rigorous courses are the ones who are most qualified or motivated) by matching students based on the their advanced course-taking and they used an advanced approach called propensity score matching to estimate potential causal relations while controlling for numerous other variables "including eighth-grade test scores, high school fixed effects, credits earned by subject, course-taking rigor in other subjects, and student demographics and measures of educational needs" (p. 314). Long et al. (2012) found only positive results, such that taking more rigorous courses was associated with increased math test scores and increased likelihood of graduating high school and enrolling in a 4-yr college. Interestingly, the results did not change much across different demographic groups.

Using propensity score matching and sensitivity analysis, which are advanced regression procedures for interpreting causal relations, Byun et al. (2014) studied the relationship between taking advanced math courses and college enrollment and how the outcomes varied by demographics and ethnicity. Using data from a national Educational Longitudinal Study, the researchers gathered a large sample of approximately 16,000 students across the United States that took advanced math courses, beyond Algebra II,

between 2002 and 2006. Byun et al. (2014) found that while math achievement scores on standardized tests increased there remained disparities between lower and higher socioeconomic students as well as between Caucasian and African American students. However, they also found a statistically significant relationship between students who completed advanced math courses and higher college enrollment rates, without any differences between socioeconomic status and ethnicity. These findings reaffirm the results of relations between students taking advanced math courses and college readiness and enrollment which have been found in previous studies by Gamoran and Hannigan, (2000), Adelman (2006), Attewell and Domina (2008), and Long et al. (2012).

In 2013, the state of Florida increased the math course requirements for high school graduation by including Algebra II. Kim et al. (2015) tested the rationale behind this policy change by using longitudinal student data from the school districts in Florida involving over 750,000 students in grades seven to 12 from 1995-1996 to assess the effects of completing advanced math courses in high school on college enrollment and completion. Kim et al. (2015) used an instrumental variable approach involving multiple logistic regressions and controlled for demographics of income, gender, ethnicity, high school GPA, and SAT scores, as well as district and school differences within and across cohorts. The researchers found that students who successfully completed Algebra II in high school had higher college enrollment and completion rates at 2-year colleges; however, there was no significant effect on 4-year degree completion.

To address student failure rate in algebra, the Chicago Public Schools implemented a new “double-dose policy” (p. 109) in 2003 to extend the instructional time

for algebra and to emphasize critical thinking and problem solving skills for low achieving 9th graders (Cortes et al., 2015). Algebra is a prerequisite course for many college majors and is considered a gatekeeper course for postsecondary success (Wilderson et al., 2018). Student failure in algebra prevents students from participating in more rigorous math courses in high school and reduces college readiness and enrollment. The goal of the policy was to increase student success in algebra in order to promote the completion of more advanced math courses in high school, thus increasing college enrollment (Cortes et al., 2015).

Cortes et al. (2015) tested the effects of this double session algebra policy by examining students entering high school in 2003 and 2004. The researchers conducted a longitudinal regression discontinuity analysis, controlling for demographic variables of gender, race, and economics, in order to compare the effects between two cohorts: the students who scored below the 50th percentile on the 8th grade math test and the students who scored above the 50th percentile on the 8th grade math test. The researchers reported long-term benefits of doubling the instructional time for algebra along with an increased emphasis on critical thinking and problem-solving skills. Cortes et al. (2015) found more students passing algebra, higher performance on standardized tests, improvements in the high school graduation rate, and increased college enrollment.

Royster et al. (2015) used longitudinal logistic regression analysis, controlling for demographic variables of race, parent education, and gender, in order to assess effects of college prep courses on college readiness in a sample of students from a specific urban public school district in Kentucky. The researchers separated the data into two datasets,

one for English readiness and another for math readiness. Royster et al. (2015) found several positive results such that increasing college prep course-taking and college aspirations was associated with college readiness. For English, students with college prep courses were 1.5 times more likely to meet college readiness benchmarks of ACT scores. For math, students with college prep courses were 3.16 times more likely to meet college readiness benchmarks of ACT scores. Students with college aspirations were 1.68 times more likely to be math-ready for college. However, the researchers also found some negative results. Students who participated in extracurricular college prep courses were 1.31 times less likely to be English-ready for college and 1.42 times less likely to be math-ready for college.

In a study inspired by Conley's (2014) college readiness framework, Woods et al. (2018) tested the effects of a new Florida law passed in the last five years allowing high school students to opt-out of college placement tests and instead enroll directly in college-level courses despite their previously demonstrated academic inability. The goal of their study was to see if high school transcripts and course information could predict which students would succeed or fail. The analysis included around 28,000 first-time-in-college students (who did not take a placement test or developmental course) in the Florida College System in fall of 2014. Woods et al. (2018) defined college readiness as graduating high school and passing the first year of college courses without remediation. The researchers used multiple logistic regression controlling for demographic variables of racial/ethnic and economic diversity to determine if students with higher levels of academic preparation (particularly in math and English) in high school were predicted to

perform better at introductory-level college courses. Specifically, earning high grades in high school English predicted high grades in college English courses, while high marks in high school math and science courses predicted high marks in college math and English. The "well prepared students" showed overall low passing rates for their college courses, around 70% in English and around 48% in Intermediate Algebra, despite those positive effects, indicating that advanced high school coursework is beneficial but not enough on its own to determine success in college.

Le et al. (2016) tested the college readiness outcomes from a College Bound program in St. Louis involving 384 students across seven cohorts from the program from 2007 to 2014. The methods included propensity weighting between treatment (College Bound students) and control (non-College Bound students) groups, and chi-square tests of independence and linear regressions. Le et al. (2016) reported several positive differences between groups. College Bound students showed increased End-of-Course exams in English and biology, increased course grades, more AP courses taken, higher college enrollment (90% vs 75%), and increased likelihood to enroll in 4-year vs 2-year colleges. However, the researcher also reported no effect on ACT performance and no difference in college persistence, which was defined as enrolling in at least one additional term after the first term.

Jacob et al. (2016) tested the effects of the Michigan Merit Curriculum (MMC), a new policy implemented in Michigan in 2008, involving a college-prep curriculum required for graduation that included Algebra II, four years of English, and two years of a language other than English. The goal of the MMC was to increase college readiness by

improving math and science skills, and "the theory underlying the Michigan Merit Curriculum is that students, teachers, and schools will rise to the higher expectations, leading to an increase in academic achievement and attainment" (Jacob et al., 2016, p. 3). The study compared between three prepolicy cohorts of students (2005-2007) and three postpolicy cohorts (2008-2010). Jacob et al. (2016) used an advanced multiple regression procedure known as interrupted time series on longitudinal data from individual students to see how the policy's impact changed previous trends in academic performance. The researchers also compared longitudinal changes in Michigan to longitudinal changes in other states which also implemented new graduation policies. The researchers controlled for 8th grade math performance and student demographic variables. College readiness was defined as earning a high school diploma as well as performance on the Michigan Merit Exam and AP exam. Jacob et al. found several positive results. Students who entered high school with the lowest grades saw the highest ACT composite score gains (i.e., 0.35 points or 0.15 standard deviations) from the new policy. ACT science scores improved on average by 0.2 points (0.04 standard deviations). Cross-state analysis comparing Michigan policy changes to Colorado and Illinois policy changes showed comparable effects of some positive increases in science but not math ACT scores. Jacob et al. also found several negative results. There was no substantial evidence that the new policy improved graduation rates; rather, there was a small effect of the new policy with a decrease in the number of high school graduates from students who entered high school with the lowest academic performance (e.g., 0.22 standard deviation increase in science ACT score). As the authors noted, "We suspect that this was caused by higher failure

rates among low performing students pushed into more difficult courses by the new requirement" (p. 33). Cross-state comparative analysis suggested a small reduction of Michigan high school graduation rates as compared to other "control" states with similar graduation policies – Alabama, Alaska, Connecticut, and Vermont. From these results, the authors suggested that raising course requirements alone is insufficient to significantly increase achievement and college readiness, and that requiring more rigorous courses can negatively impact the lowest performing students.

Buddin and Croft (2014) tested the effects of a new policy implemented in Illinois in 2005 which increased the requirements for math to 3 years and the requirements for science to 2 years in order to earn a high school diploma. The researchers focused on a nine-year timespan of data (2005-2013) for most public high school districts in Illinois, involving more than 800,000 math and science ACT test scores in that timespan. Their analysis involved comparing across school districts: the school districts with the new math/science requirements already in place served as the control group (i.e., the "untreated" districts), whereas the school districts which newly adopted the requirements were the treatment group (i.e., the "treated" districts). Buddin and Croft used multiple regression controlling for student demographics and cross-district nonspecific effects. The researchers found only one change: a slight increase in science course-taking but found no change in math course-taking, no change in college enrollment, no increase in science AP scores, and decreased science AP scores for the lowest achieving students. Buddin and Croft (2014) reported no overall effects on the three separate groups of students who should have benefited the most from the new policy: low class rank

representing the lower half of graduation class, low GPA with a B- or lower average, and non-college prep representing students not enrolled in a college prep program.

Several studies have addressed the potential efficacy of increased curricular rigor on college readiness without assessing the impact of new policy implementation. For example, Howard et al. (2015) assessed the effects of taking more advanced math courses of Algebra I and II in eighth grade and high school on algebraic reasoning proficiency and college readiness. College readiness was defined in an unusual way as students' self-report on whether or not they think they will meet minimum enrollment requirements for community college, typical 4-year college, or selective 4-year college. Howard et al. (2015) compared data from 2009 and 2012 taken from the national high school longitudinal study, providing a sample size of over 21,000 students from 944 US schools and including a wide variability of demographics (e.g., gender, race, language status, locale, region, SES) which were controlled for in their logistic regression analysis using Propensity Score Matching similar to Byun et al. (2014). The researchers found several results related to increased math course-taking. There was no difference in math proficiency between students who did not pass eighth-grade Algebra I and students who passed lower-level courses. Both groups of students who did not pass eighth-grade algebra and students who passed lower levels were less college ready than other students who passed Algebra II. In other words, if students passed eighth-grade Algebra I, they perceived themselves as more college ready. Students who passed lower-level math courses in 8th-grade were higher in college readiness than students who failed 8th grade Algebra. Students who did not pass eighth-grade Algebra showed lower scores on their

mathematical interest, how useful they perceived math to be, and how much they identified themselves as mathematical thinkers. These findings argue for the positive benefit of increased math course-taking for subsequent college readiness, specifically in the context of students' self-perception.

Plunk et al. (2014) conducted a large study on the outcome results from all the course graduation requirement policies implemented throughout all of the United States from the 1980s to the 1990s. This was the first study to investigate both math and science reforms in the same analysis. The motivation of the study was to test the educational premise of benefits expected from increased academic course rigor in high school. The researchers tested three different indicators of college readiness: earning a high school diploma, enrolling in college, and college graduation. Using a so-called "difference-in-differences" approach, they conducting logistic regression to test effects of new policies by comparing prepolicy and postpolicy groups and by running separate analyses by gender and race/ethnicity to test for differential effects. Plunk et al. (2014) found some positive effects of the new policies, such as increased college graduation for students who completed the highest requirements in high school (i.e., six classes), and these increases were larger for African American and Latinx men and women. On the other hand, they found some negative effects of the new policies, such as increased drop-out rates for particularly Black and Hispanic students (1.88% to 2.58%, respectively), and no overall effects on college enrollment and even decreased rates, up to 3-5%, for African American women and Latinx men and women.

ACT (2013) recommended some College Readiness Benchmarks based on minimum ACT scores in English, Algebra, Social Sciences, and Biology, among others, required for college readiness. ACT researchers used summary statistics taken from internal analysis of their database to report several positive findings. According to their report, students who pass the ACT Benchmarks have higher college persistence and degree completion. ACT researchers also found that racial and economic gaps decrease among the students who are college ready (i.e., who pass the ACT benchmarks), and that students who are monitored early on for their progress are more likely to complete college degree.

Mazzeo (2010) conducted a literature review related to a 1997 study to investigate 1997 reforms in Chicago Public Schools (CPS) for mandatory college-prep curricula (i.e., four years of English, three years of math, three years of lab science, three years of social science). Several positive effects were found by previous studies. The new policy led to increased student enrollment in college-prep mandatory courses (e.g., 90% enrolled), especially for underperforming students, and it decreased racial/ethnic and achievement gaps in enrollment of those courses. However, there were no positive effects on achievement measures. There was no effect on math and English test scores. However, the results showed lower grades and higher failure rates in math and English for the lowest performing students. Higher performing students showed increased absentee rates and there was no increase in college enrollment or college persistence. Jacob et al. (2016) also summarized similar findings in reference to research on the 1997 Chicago policy conducted by Allensworth et al. (2009) and Montgomery and Allensworth (2010). While

there was a decrease in gaps between racial/ethnic groups and highest versus lowest achieving students, there were also negative unintended consequences of decreased Algebra I grades and increased failing, no increases in advanced math course enrollment, no effects on standardized tests or college enrollment, and a decrease in high school graduation rates for several years after the new policy.

Jha and Stearns (2017) examined the association of high school students who successfully completed rigorous courses with college enrollment and completion. The researchers specifically investigated whether there were differences in the outcomes between ethnic groups while controlling for socioeconomic status. The findings are consistent with the association of completing rigorous courses in high school with increase in college attendance and completion; however, not all ethnic groups experienced the same boost in 4-year degree attainment. Asian Americans were more likely to attain a 4-year degree than White students, and African Americans were significantly less likely to earn a bachelor's degree than White students. Their study is in support of the connection of completing more rigorous courses in high school with college enrollment; however, this may not be the case for all student demographic groups.

Jackson and Kurlaender (2014) examined how high school GPA, academic course completion in high school, and student demographics predicted college outcomes by investigating student persistence and degree completion within six years from enrollment in California's 23 4-year public universities. High school GPA was found to be a strong predictor of college success and therefore a good indicator of college readiness (Jackson

& Kurlaender, 2014). Students who were academically prepared with a GPA above a 2.86 were six times more likely to persist and over eight times more likely to complete their degree (Jackson & Kurlaender, 2014).

Rivkin and Schiman (2015) used multiple regression involving both student-specific models and grade-specific models to assess the popular notion that increasing instruction time and quality improves academic outcomes. The researchers used data collected from the 2009 PISA worldwide survey of 15-year-old students who reported the number of weekly attendance rate of different classes and average duration of those classes. The result was quite positive, such that increasing instruction time helps to increase achievement in math and language arts, depending on the amount of time increased and the quality of instruction and classroom setting (e.g., student-teacher interactions). Rivkin and Schiman (2015) concluded that whether or not increasing instruction time actually causes increases in achievement probably depends heavily on instruction quality, classroom quality, and student effort.

Preston et al. (2017) conducted a comprehensive literature review of aligning curricular rigor between high school and college. The researchers reported that several studies published in the late 1990s or early 2000s reported positive results of increasing curricular rigor, including increased academic performance, high school graduation rates, college enrollment and completion rates. Preston et al. (2017) proposed that "effective schools not only increase curricular rigor but also provide support systems and promote equal access to resources and create variability in options" (p. 536-537). The researchers also noted that several previous studies reported negative results of increasing curricular

rigor, particularly for minority groups, such as higher dropout rates and lower high school GPA. Preston et al. (2017) further emphasized that racial/ethnic and economic gaps in academic achievements remain, despite three decades of new policies to help reform the issue, leading them to conclude that "the evidence is weak or mixed for any structural or organizational change alone leading to improved student outcomes" (p. 526).

Policies mandating that students take more rigorous courses in high school do not only come from K-12 school districts but they have also come from university systems. In North Carolina, there was a policy change mandating the completion of four years of mathematics instead of three years in high school in order to be eligible for admittance to the University of North Carolina system. Clotfelter et al. (2018) investigated the impact of the policy using regression analysis with a large sample of eighth grade cohorts across school districts in North Carolina from 1999 to 2006. The researchers found that college enrollment was positively affected in the University of North Carolina school system. However, the increased rates were highest for the groups of students from which the universities were already accepting, suggesting that the policy's effect on college enrollment particularly affected the highest performing students. The policy also preferentially increased the college-going rates of black students to minority-serving institutions. Other positive effects of the new policy included postpolicy increases in math course-taking, with largest increases for students with low 8th grade math scores, as well as higher high school graduation rates for both high and low achievers.

Researchers have found positive outcomes for high school students successfully completing a college preparatory curriculum whether or not they attend college. Hull and

Dillon (2016) conducted a longitudinal study through the U.S. Department of Education investigating the outcomes of college and non-college goers. Hull and Dillon (2016) found positive outcomes regarding students who completed a college preparatory curriculum in high school with at least a C+ high school GPA. The researchers found that those who obtain college degrees have more job security, higher incomes, increased participation in society, and more contributions to retirement (Hull & Dillon, 2016). The differences shrink when comparing college and non-college goers that completed a college preparatory curriculum in high school with at least a C+ GPA (Hull & Dillon, 2016). Thus, these findings are in further support of the benefits of completing rigorous courses in high school regardless of whether students plan to complete a college degree.

A relatively consistent pattern across this review of the quantitative research literature on this topic is that the challenge of how to increase college readiness is a complex and multidimensional issue. It involves several types of policy interventions that have been attempted throughout recent decades by various local schools, districts, and states. Perhaps the most common approach has been, like the new policy implemented by some school districts such as the local site of the proposed study, to mandate more rigorous courses for high school graduation. A large majority of these new policies specifically increased math course-taking – such as minimum math policy implemented in North Carolina (Clotfelter et al., 2018), Chicago Public School system's "double-dose algebra" policy (Cortes et al., 2015), California's mandatory Algebra I in 8th grade (Domina et al., 2015), and Florida's mandatory Algebra II policy for high school (Kim et al., 2015). Other policies usually included math as well as English or science

requirements – such as the Michigan Merit Curriculum (Jacob et al., 2016), California's new curriculum (Betts et al., 2013, 2016; Gao, 2016), and Illinois' math and science policy (Buddin & Croft, 2014). Other approaches that have been used have been more voluntary, comprehensive programs like St. Louis' College Bound (Le et al., 2016) or Florida's more novel "opt-out" policy for direct transition from high school to college (Woods et al., 2018).

Outcomes of Attempted Policy Changes

Similar to the variety of different policies attempted, there has been a large variety of outcomes from these policies, including both intended and unintended consequences. These outcomes have been demonstrated by researchers directly assessing the efficacy of new policies implemented or by other researchers assessing the overall impacts of increasing curricular rigor of math or other subjects (Buddin & Croft, 2014; Byun et al., 2014; Howard et al., 2015; Kim et al., 2015; Long et al., 2012; Mazzeo, 2010; Preston et al., 2017; Rivkin & Schiman, 2015; Royster et al., 2015). Intended positive and unintended negative outcomes have included both increased and decreased course-taking, performance in courses or on standardized tests, overall high school GPA, earning a high school diploma, college enrollment, and persistence in college, as well several examples of unintended absence of effects on these outcome measures.

A common strategy for increasing college readiness has been to increase curricular rigor and graduation requirements in order to increase the vertical alignment of high school students' academic achievement with the increasingly demanding eligibility requirements and curricular rigor of postsecondary education. Despite the prevalence of

such policies enacted at local district or statewide levels, there is a growing consensus in the recent literature that there exists a knowledge gap regarding the efficacy of these policies for improving college access and readiness. Many influential researchers have addressed this concern. For example, Buddin and Croft (2014) stated that "While stricter graduation requirements have become common legislative tools, there has been little research evidence on the effectiveness of these requirements on student outcomes" (p. 2). Mazzeo (2010) explained that although policies that increase high school course requirements have intuitive appeal, "surprisingly little is known about whether changing course requirements will necessarily lead to improved outcomes for students" (p. 1). Preston et al. (2017) reported that despite three decades of new policies to help reform the issue, racial, and economic gaps in academic achievements remain, and they concluded that "the evidence is weak or mixed for any structural or organizational change alone leading to improved student outcomes" (p. 526). Le et al. (2016) stated that "despite the intense amount of planning, effort, and resources devoted to implementing college readiness interventions, relatively little is known about their effectiveness" (p. 263). Jacob et al. (2016) echoed this sentiment with their conclusion that "there is less evidence on how such policies impact student achievement, but the existing research generally does not find large gains in student performance" (p. 4). In a quasi-experimental study in support of such policy, Long et al. (2012) emphasized "a lack of experimental or rigorous quasi-experimental evidence to support…federal, state, and local policy initiatives that aim to increase the number of students taking rigorous courses" (p. 314). Similarly, Domina et al. (2015) stressed that "relatively few studies have attempted to estimate the

effects of advanced course-taking in experimental or rigorous quasi-experimental settings, and those that do have returned sharply mixed results" (p. 277).

Strengths of Previous Research

I can identify several strengths inherent to the research identified above concerning the potential effects of new graduation requirement policies on college readiness outcomes. The first strength in common across those studies is that they used quantitative methodology to analyze links between the independent variable, the newly implemented policies which are often defined or coded by comparing across prepolicy and postpolicy groups, and the dependent variables of college readiness outcomes. Quantitative methods are ideal for measuring and testing variables in large samples of students or districts and for generalizing these findings to the rest of the student/school populations of interest (Barnighausen et al., 2017; Reio, 2016). The prevalence of these quantitative methodologies in the literature on this topic provided the rationale for a quantitative design of the currently proposed study. These previous studies provided the inspiration for using this comparison technique. A second strength is that many of the previous studies, although certainly not all, used only one or two measures of college readiness as variables in their analysis. Therefore, the use of a single indicator of college readiness, student high school GPA, grounded in strong theory in the currently proposed study can be considered a major advantage. A third strength is the fact that many of those studies used very large sample sizes involving heterogeneity of individuals and schools/districts – typically upwards of 10,000 students overall or per group (e.g., Buddin & Croft, 2014; Byun et al., 2015; Howard et al., 2015; Long et al., 2012), or in the

hundreds of thousands (e.g., Domina et al., 2015; Kim et al., 2015), or even more than one million (Plunk et al., 2014). These large sample sizes enabled the appropriate use of their sophisticated quantitative methods, the statistical power and reliability of those results, and the generalizability of those results to the rest of the student or school populations of interest. This strength also applies to the currently proposed study, which involves a sample size of more than 160,000 students per comparison group, in order to generalize to the large local school district of interest and to the rest of the country.

Limitations of Previous Research

I can identify some limitations inherent to many of the studies in this literature review which have been improved in the current study. First, although there were some notable exceptions (e.g., Cortes et al., 2015; Domina et al., 2015; Kim et al., 2015; Le et al., 2016; Rivkin & Schiman, 2015; Woods et al., 2018), most of the studies were not guided by strong theoretical frameworks of college readiness despite their aim to understand how new policy impacts college readiness (Betts et al., 2013; Betts et al., 2016; Buddin & Croft, 2014; Byun et al., 2015; Long et al., 2012; Mazzeo, 2010; Plunk et al., 2014; Preston et al., 2017; Royster et al., 2015). This is a substantial limitation of the interpretability of their results given the complex nature of college readiness that has been widely discussed in several different theoretical frameworks, definitions, and guidelines on college readiness (Bryan et al., 2015; Conley, 2014, 2017; Hatch, 2013; National High School Center, 2008; Perusse et al., 2015; Preston et al., 2017). The current study avoids this limitation by being grounded in Conley's (2014, 2017) theoretical framework of college readiness, which has also been used by other studies

(Domina et al., 2015; Woods et al., 2018), in order to appropriately select high school GPA as the dependent variable that best captures college readiness. A second weakness is that many of the studies used sophisticated quantitative procedures – such as traditional multiple regression (Rivkin & Schiman, 2015; Woods et al., 2018) or more advanced regression procedures such as instrumental variable modeling (Clotfelter et al, 2018; Kim et al., 2015), regression discontinuity analysis (Cortes et al., 2015), and propensity score matching or sensitivity analysis (e.g., Byun et al., 2014; Long et al., 2012) – to test for relations between numerous interacting variables and for the purpose of indirectly inferring potentially causal relations (e.g., the effect of a new policy on college readiness outcomes) in their quasi-experimental design, which by definition does not allow the direct test of causality because it cannot experimentally manipulate the independent variable or randomly assign students to different conditions (Barnighausen et al., 2017; Leiber et al., 2015; Reio, 2016). Notably, several studies employed the so-called "difference-in-differences" approach (Betts et al., 2013, 2016; Domina et al., 2015; Kim et al., 2015; Le et al., 2016; Long et al., 2012; Plunk et al., 2014), also known as a causal comparative design (Busk, 2017; Reale, 2014; Wells et al., 2015), to indirectly test the potential causal influence of new policy on college readiness by comparing prepolicy and postpolicy cohorts. I avoided such complexity by using a simple independent samples *t*-test analysis to test for differences in only one dependent variable (i.e., high school GPA, an indicator of college readiness) across prepolicy and postpolicy student groups.

Gap in Practice

It is clear from these examples in the literature that there is the presence of a gap between research and educational policy and practice. This is a gap that may indeed be eventually bridged by increasing experimental or quasi-experimental quantitative research as suggested by some scholars (Long et al., 2012; Domina et al., 2015). A primary challenge of this issue is trying to determine whether or not increasing graduation requirements actually causes improvements in college readiness. Such a causal claim would require true experimental research involving random manipulation of graduation policies or random assignment of students to such curricular requirements, an approach which is not very feasible in practice and also ethically prohibitive. Therefore, most previous quantitative research on this issue has used quasi-experimental approaches, such as comparing before and after policy implementation, to uncover potentially causal associations between policy and outcomes. The need for more research of this type thus justifies the current quasi-experimental quantitative study regarding the potential benefits or disadvantages of increasing graduation requirements for college readiness as indicated by student high school GPA.

Literature Provides Rationale for New Graduation Policy

School Board members based the rationale for the policy change's inclusion of the new courses in the high school graduation requirements based on the rich literature on this topic. The 4-year public state university system specifically identified the new courses to increase the curricular rigor of high school students in order to have better prepared college applicants (Douglass, 2007). School districts have adopted the new

course requirements as part of their high school graduation requirements to align with minimum course requirements for state 4-year public universities and thereby to increase college readiness (Buddin & Croft, 2014; Garcia et al., 2015; Gao, 2016; Phillips et al., 2015). This rationale also supports my use of the new curricular policy implementation as the independent variable and the assessment of its impact or efficacy for increasing college readiness among student graduates.

Studies on Policies Mandating College Preparatory Courses

There have been three quantitative studies conducted by researchers in order to specifically investigate the effects of mandating the completion of the new courses as part of new high school graduation policy in California school districts. Betts et al. (2013) reported summary statistics from three California school districts that implemented new high school graduation policies that mandated the completion of the new course sequence: San Jose Unified School District (SJUSD), Los Angeles Unified School District (LAUSD), and San Francisco Unified School District (SFUSD). SJUSD was the first district to implement this policy change in California in 2002. Examining student outcomes from over a decade, Betts et al. (2013) found little increase in college eligible graduates. For LAUSD, who implemented the policy in 2012, beginning with the graduating class of 2016, a little over half (54%) of the seniors were on-track to graduate (Betts et al., 2013). For SFUSD, who implemented the policy beginning with the graduating class of 2014, they demonstrated only a slight increase in student graduation rates of 2.2% to 83.9% (Betts et al., 2013). The researchers charted, plotted, and graphed

the findings but provided little analysis. I concluded based on these results that there is a mix of positive or null results, thus indicating the need for further research.

Betts et al. (2016) conducted a second study where they tested the effects of the new course policy, implemented in 2016 in San Diego Unified School District (SDUSD), on college readiness outcome measures by comparing between prepolicy and postpolicy student cohorts. Students were considered to be college ready if they completed all new courses with a grade of a C or better, qualifying them to apply to the California State Universities (CSU) and University of California (UC) institutions. Betts et al. (2016) reported increases in a new course completion and that the subsequent students from the class of 2017 were attempting and completing approximately 3% more new courses with higher grades of a C or better.

Betts et al. (2016) also found that, because students were completing the required courses for 4-year public state university admissions, more students were accessing postsecondary 4-year universities, including those traditionally underrepresented. The researchers showed results that, by the 11th grade, students from the group with the lowest likelihood of completing the new course sequence demonstrated significant increases in new course participation. Students from parents without a college education were more likely to complete the new course sequence, however they still lagged behind the percentage of students from parents with college degrees. The researchers found that college readiness, as defined by the completion of the new courses with a C or better, increased over 10% between the class of 2011 and the class of 2016. Additionally, there was no evidence found for the risk of the new policy negatively impacting high school

GPA, attendance rates, school switching, or the taking of career and technical education courses. However, despite these positive results, the authors noted, “there could be unintended negative consequences that harm the very students the policy seeks to assist” (p. 18). Betts et al. (2016) found that the students from class of 2016 lagged behind the average new successful completion rates of the classes of 2011-2013. The predicted graduation rate of the class of 2016 (72%) was 15.5% lower than the prepolicy rate for the class of 2014 (87.5%). Many of the students off-track for graduation had a high school GPA below a 2.0, the minimum requirement for high school graduation in the district. The authors noted that many students faced “double jeopardy” (p. 13) needing to not only successfully complete the new courses but also increasing their GPAs. Disparities were also evident among demographic groups, with Hispanics, African American, students with disabilities, and English learners making up the larger percentages of students not on-track to graduate. The researchers also noted that students were predominantly failing English and mathematics courses as compared to other subjects. While the researchers of this study found positive relationships between the high school graduation policy change and student college readiness, they also raised questions and concerns about the policy’s effectiveness for all students, indicating a need for further research on this topic.

In a third study, Gao (2016) included summary statistics averaging new curricular completion rates across all major California school districts from 2000-2014. Only a handful of districts were mandating the completion of the new courses at that time. Gao (2016) found a mixture of both positive and negative results. The Latino population

progressed the most in the new course completion, showing a 51% increase between 2000 to 2014 (Gao, 2016). Gao reported an almost 50% increase in Algebra 2 course enrollment, however the overall rate was still quite low at around 30% by 2012. Gao indicated that the results show moderate increases in high school graduates successfully completing new courses by 10%-20% (Gao, 2016). However, there were differences among demographic groups and socioeconomically disadvantaged students who did not experience the same increases as Caucasian, Asians, and more affluent peers (Gao, 2016). The new completion rates in low-minority schools were double the rates in high-minority schools.

The vertical alignment of academic expectations between high school and college courses is at the heart of graduation and curricular policy changes in California (Betts et al., 2016; Gao, 2016; Philips et al., 2015), the minimum math requirements used in North Carolina (Clotfelter et al, 2018), the double-algebra policy used in the Chicago Public Schools (Cortes et al., 2015) and Florida school systems (Kim et al, 2015), the Michigan Merit Curriculum for college-prep in particularly math and science (Jacob et al., 2016), as well as other approaches such as dual-enrollment programs (Saavedra, 2018; An & Taylor, 2015; Ferguson et al., 2015), the college-bound "Get Your Prep On" program used in St Louis (Le et al., 2016), and STEM intervention programs (Lane et al., 2017) or STEM-focused high schools (Means et al., 2016). Adoption of new graduation requirements in school districts within California or other states often coincides and benefits from partnerships between local high school districts and community or state colleges (Preston et al., 2017). For example, the Los Angeles Unified School District

partnered with the Los Angeles Education Research Institute (LAERI), in association with the University of California, Los Angeles (UCLA), "with the goal of informing policy, transforming practice, and improving student outcomes through rigorous research" (Phillips et al., 2015, p. 142). A primary objective of the LAUSD-LAERI partnership is to better assess the practical implications, particularly regarding college eligibility and readiness, of LAUSD's implementation of the new curricular requirements (Phillips et al., 2015, p. 142). Phillips et al. (2015) acknowledged that there is a need for this research because LAUSD's adoption of the new curricular policy may result in both intended increases in college readiness and enrollment, or unintended consequences such as decreased college readiness and high school graduation rates. The researchers further emphasized that most previous research has focused on how new policies and indicators can best predict high school graduation rates, although the focus is now changing on how to best predict college readiness variables such as college enrollment, persistence, and degree obtainment with typical academic indicators such as high school GPA, advanced courses taken, college entrance exam scores, and more non-typical indicators such as college aspirations.

Key Independent Variable: Increasing Curricular Rigor

The key independent variable of this quantitative study reflects the concept of increasing curricular rigor and graduation requirements that is represented by a large urban district's implementation of a new curricular policy required for high school graduation. The 4-year public state university institutions uniformly mandate the completion of a minimum set of 15 course requirements for admission eligibility

(Department of Education, 2018). Several districts beginning with San Jose Unified and including Carlsbad Unified, Los Angeles Unified, Morgan Hill Unified, Oakland Unified, Palo Alto Unified, San Diego Unified, San Francisco Unified, Santa Ana Unified, Sonoma Valley Unified, Sweetwater Union, and Vallejo City Unified school districts have included the new courses as part of their high school graduation requirements (Betts et al., 2016; Leal, 2015). The courses span seven content areas, each with a minimum time requirement and include the following: history/social science ("a"), English ("b"), mathematics ("c"), laboratory science ("d"), foreign language ("e"), visual and performing arts ("f"), and college preparatory elective ("g"). In an effort to increase college readiness and enrollment, the district board of education aligned the high school diploma requirements with the minimum course entrance requirements for 4-year public universities by adding the courses to the graduation requirements in 2012 (Martinez et al., 2012). The class of 2016 was the first cohort under this new policy and students were required to complete each of the courses in order to earn a high school diploma.

Key Dependent Variable: High School Grade Point Average

High school GPA aligns with all aforementioned definitions of college readiness: it reflects Conley's Keys 1-3 (i.e., the respective domains of cognitive ability, knowledge, and learning skills - Conley, 2014); it is recommended by NOSCA as the performance aspect of academic planning (College Board, 2010; Perusse et al., 2015); and it is recommended by Bryan et al. (2015) and Hatch (2013), and by Nagaoka et al. (2013) as an important part of students' academic factors.

There is substantial research evidence to support the inclusion of high school GPA as a marker for college readiness. Previous studies have found that students with a high school GPA of a 3.0 or higher are more likely to pass college courses and persist to earning a college degree (Balfanz et al., 2016; Hein et al., 2013; Jackson & Kurlaender, 2014). High school GPA more highly correlates with postsecondary student performance than performance on the ACT used for college admissions (Westrick et al., 2015). Furthermore, ACT (2013) reported that using multiple measures including high school GPA is more predictive of success in college: "For students who meet the same number of ACT Benchmarks, degree completers are more likely than non-completers to have a GPA of 3.00 or higher" (p. 4). Indeed, other researchers have shown GPA to be predictive of college success even more than standardized tests (Hiss & Franks, 2014; Hodara & Cox, 2016; Hodara & Lewis, 2017). Moreover, high school GPA not only reflects student academic achievement but reveals non-cognitive aspects of study habits, time management, grit, and motivation that play an integral role in college readiness and postsecondary success (Mattern et al., 2014). Conley (2014) further emphasized that high school GPA is a predictor of college readiness because "it is a measure not only of academic knowledge and performance, but of a whole series of meta-cognitive learning skills such as time management, study skills, help-seeking strategies, persistence, and goal focus" (p. 14).

High school GPA has been used by some previous studies as an indicator of college readiness with which to assess the efficacy of new policies implemented for the purpose of increasing college readiness. Betts et al. (2016) explained the risk of the new

curricular policy negatively impacting high school GPA in that the students "face double jeopardy", that is, they are required to take more rigorous classes while simultaneously increasing their grades and high school GPA. However, they found no evidence of SDUSD's implementation of the new curricular policy negatively impacting high school GPA for separate grades nine through eleven. Instead, they found that the postpolicy class showed completion of more courses with higher grades of C or better which would positively affect high school GPA. However, when Chicago Public Schools mandated a college preparatory curriculum, it resulted in lower grades and high school GPAs especially for the lower performing students entering high school (Allensworth et al., 2009). Buddin and Croft (2014) did not directly assess effects of a new math/science policy on high school GPA but they showed that, for the low-high-school-GPA group for whom the policy should have benefited the most, there were no effects on their math/science course-taking and test scores or their college enrollment. ACT (2013) reported that students taking a core curriculum of increased rigor, three years of math, science, and social studies were more likely to have a high school GPA of 3.0 or higher in their first year of college. Le et al. (2016) showed that the College Bound program in St. Louis increased course grades. Researchers investigating the 1997 Chicago policy for increasing Algebra requirements demonstrated that the new policy resulted in decreased Algebra I grades (Allensworth et al., 2009; Montgomery & Allensworth, 2010).

Summary and Conclusions

Previous research has shown that high school GPA can be an important predictor of college success, can be a useful criterion for eligibility selection by colleges, and is

highly recommended by published guidelines as an indicator of college readiness. Furthermore, this study was grounded in the framework by Conley (2014) who recommended using high school GPA as an indicator variable of college readiness because it aligns well with the three keys of "think" (cognitive ability), "know" (content knowledge), and "act" (academic behaviors). Conley (2014) also proposed that it is "the strongest predictor of postsecondary success" (p. 14). These reasons and the consensus in the research literature justify the inclusion of high school GPA as the measurement of college readiness used as a dependent variable in the current study. High school GPA and the closely related measure of grades have also been used by previous quantitative research studies as a dependent variable for assessing the impact of new graduation policies as an independent variable. The pattern of results across these studies is very mixed, with all possible positive or negative effects or even lack of effects reported, thereby indicating evidence for unresolved controversy regarding the efficacy of such policies for improving college readiness. The presence of these contradictory results and the gap in policy and practice about the effect of new curricular policies on high school GPA, an important indicator of college readiness, thus justifies the rationale of the current study's research question for assessing how high school GPA was influenced by the implementation of the new policy mandating the completion of a college preparatory curriculum. In Chapter 3, I present the details of the research design and methods used in this study.

Chapter 3: Design, Rationale, and Methods

The problem addressed in this study was the uncertain influence of a local curricular policy on potential changes in college readiness of high school students. The purpose of this ex post facto study was to investigate how a change in local curricular policy may or may not have influenced high school graduates' college readiness, as measured by high school GPA. In this chapter I describe in detail the quantitative nature of this study, the rationale behind the study design, the operationalization of dependent and independent variables, the population and sampling of the study, data analysis strategy for analyzing archival data, and potential validity threats and ethical issues.

Research Question and Hypotheses

RQ1: How do high school GPA scores differ before and after implementation of a local curricular policy change?

$H_0$1: There is no statistically significant difference in the high school GPA scores before and after the implementation of a local curricular policy change.

H_a1: There is a statistically significant difference in the high school GPA scores before and after the implementation of a local curricular policy change.

RQ2: How does college eligibility differ before and after the policy change, as measured by the number of high school students who graduated with a GPA of 3.0 or higher (minimum eligibility for the state's advanced 4-year universities), with a GPA between 2.0 and 2.99 (minimum eligibility for the state's standard 4-year universities), or with a GPA below 2.0 (not eligible for a state 4-year university)?

$H_0$2: There is no statistically significant difference in the college eligibility before and after the policy change, as measured by the number of high school students who graduated with a GPA of 3.0 or higher (minimum eligibility for the state's advanced 4-year universities), with a GPA between 2.0 and 2.99 (minimum eligibility for the state's standard 4-year universities), or with a GPA below 2.0 (not eligible for a state 4-year university).

H_a2: There is a statistically significant difference in the college eligibility before and after the policy change, as measured by the number of high school students who graduated with a GPA of 3.0 or higher (minimum eligibility for the state's advanced 4-year universities), with a GPA between 2.0 and 2.99 (minimum eligibility for the state's standard 4-year universities), or with a GPA below 2.0 (not eligible for a state 4-year university).

Research Design and Methodology

I used an ex post facto quantitative study design to investigate whether there was a significant difference in college readiness as measured by high school GPA, before and after a policy implementation in a selected school district. I chose a quantitative methodology because the purpose of this study was to assess how a new graduation policy relates to differences in college readiness before and after policy implementation as measured quantitatively by high school GPA, a widely used and highly recommended measure of college readiness. I chose an ex post facto design because it is known to be appropriate for assessing a link between dependent and independent variables after data have already been collected. Vogt (2005) described an ex post facto research design as

"an investigation using existing data rather than new data gather specifically for the study. This means that causes will be studied after (post) they have had their effect" (p. 114). A causal-comparative design might be used to quantitatively compare a dependent variable measure across levels of an independent variable (Busk, 2017). However, an ex post facto design is more appropriate for analyzing existing differences in a dependent variable across levels of an independent variable without making strong claims about the causal nature of the effect. A causal-comparative study would also require controlling for numerous potentially confounding variables such as student or district changes that also occurred during the policy change. If I controlled for potentially confounding variables, I would have needed a more complex statistical analyses such as multiple regression that have been used by previous studies to understand how policy change can cause effects in college readiness measures such as high school GPA (Byun et al., 2014; Long et al., 2012).

I operationalized the new graduation policy increasing course requirements with an independent variable called Cohort with two groups of students from the local site: the prepolicy classes of 2013, 2014, and 2015 high school graduates, before policy implementation, and the postpolicy classes of 2016, 2017, and 2018 high school graduates, the first graduating cohorts affected by the new graduation policy. I only included high school graduates who earned a diploma in this study sample because the primary research problem concerns potential changes in college readiness in high school graduates after implementing the new graduation policy. I operationalized the key concept of interest to this study, college readiness, with a continuous dependent variable

called high school GPA that the district calculates for each student graduate as the average grade point across all of their high school courses within a range from 0 to 4.0. I investigated the research questions regarding the potential influence of the local site's graduation policy on the GPA of graduates by comparing the students' high school GPA, the dependent variable, between the prepolicy and postpolicy groups of the cohort, the independent variable. This is a well-validated procedure used in several previous quantitative studies investigating the connection between policy changes mandating the completion of more rigorous courses and college readiness as measured by student high school GPA (Betts et al., 2013; Betts et al., 2016; Domina et al., 2015; Kim et al., 2015; Le et al., 2016; Long et al., 2012; Plunk et al., 2014). Archival data was available from the selected local district and included a large data set including approximately 80,000 students in each of the prepolicy cohorts of 2013-2015 and the postpolicy cohorts of 2016-2018. This sample size was sufficient to ensure enough statistical power to detect potential effects and robust estimation of the analysis (Rees, 2018). Please see the sample size calculation at the end of the following section.

Population and Setting

The data obtained from a district in the Western United States included the GPAs of graduates from 2013 through 2018. The chosen district was of particular interest due to its policy of mandating courses that match the minimum course requirements for entrance into a 4-year public state university (see Buddin & Croft, 2014; Garcia et al., 2015; Gao, 2016; Phillips et al., 2015). The findings from analyzing data from this local site generalize conceptually to the larger national population of approximately 3 million or

more high school graduates every year (Atwell et al., 2019). It is important to note that I excluded students with disabilities from my data analysis due to missing values. The issue of college readiness for students with disabilities was outside the scope of this study. Therefore, the results of this study do not generalize to this specific population in the local site or nationwide.

The total sample size (*N*) for this study was 161,010 students, with 79,194 students in the prepolicy cohort (i.e., classes of 2013, 2014, and 2015) and 81,816 students in the postpolicy cohort (i.e., classes of 2016, 2017, and 2018). This sample size was more than sufficient to ensure enough statistical power for detection of potential effects and for robust estimation of the analysis (Rees, 2018). I used a program called G*Power (Faul et al., 2007) to estimate the necessary sample size in each group for an independent sample *t* test based on a two-tailed test, a standard small effect size of 0.20 based on Cohen's *d* guidelines (Cohen, 1988), and a standard alpha of 0.05 corresponding to power of 0.95 to detect the effect. With G*Power, I calculated an estimated sample size of at least 651 students in each prepolicy and postpolicy group, corresponding to a minimum sample size of 1,302 students. From this calculation, I determined from this calculation that my sample size of 161,010 students was sufficient for this study.

Archival Data

I obtained archival data from the school district's student information system following the Institutional Review Board (IRB) process. I first submitted a proposal to the district committee for external research review for approval. As the study involved individual-level data, I also developed a data use agreement that was approved by the

school district's Office of Data and Accountability Research and Reporting Branch. The data use agreement was submitted with the proposal to the IRB at Walden University. Once I shared the IRB approval from Walden University, district personnel provided a Microsoft Excel file with students' pseudo ID, high school GPA, and year of graduation from the district's student information system. The year of graduation indicated whether they were in the prepolicy cohort of 2013-2015 or postpolicy cohort of 2016-2018. To prepare the data for IBM's Statistical Package for the Social Sciences (SPSS), I added a column and labeled it Cohort. To create two distinct groups, I filtered the spreadsheet by EndYear that identified the graduation year for each student, selected 2013, 2014, and 2015, and labeled them prepolicy in the Cohort column. I then filtered the spreadsheet by EndYear again and chose 2016, 2017, and 2018 and labeled them postpolicy in the Cohort column. I also created an additional column and labeled it CollegeEligible. I filtered by GPA and created three categories of the college eligible by selecting GPA 3.0 to 4.0 as eligible for the state's advanced university system (Uni3.0), GPAs between 2.0 to 2.99 as eligible for the state's standard university system (Uni2.0), and GPAs below 2.0 as not eligible for any state 4-year university (NO). In carrying out this study, the data set was converted to a CSV file and entered into SPSS. The data set consisted of scores for 161,019 graduates between 2013 and 2018, with a GPA between 0 and 4.0.

Instrumentation and Operationalization of Constructs

Using the SPSS program, I conducted the statistical analysis of the large data set in this study. For the first research question, I conducted an independent *t*-test analysis. The independent variable of cohort, containing two levels or groups of high school

student graduates from the prepolicy graduates of 2013-2015 and the postpolicy graduates of 2016-2018, operationalized the comparison between "before" and "after" the graduation requirement policy of interest. The dependent variable of high school GPA is continuous and ranges from 0 to 4.0, calculated for each student as their average grade point across all high school courses they completed. In this study, high school GPA represented the important construct of college readiness and is consistent with previous research on this topic (Betts et al., 2013, 2016; Domina et al., 2015; Kim et al., 2015; Le et al., 2016; Long et al., 2012; Plunk et al., 2014).

For the second research question, I conducted a chi-square test of independence, with two categorical independent variables and one dependent variable of counts. The first independent variable was cohort, as described above. The second independent variable was CollegeEligible, as described above. The dependent variable was the counts or numbers of high school students who graduated with a GPA in one of the three levels of CollegeEligible. I used the crosstabs procedure in SPSS to test the independence of the two categorical variables. Pallant (2010) described a chi-square test of independence as a test

> used when you wish to explore the relationship between two categorical variables. Each one of these variables can have two or more categories. This test compares the observed frequencies or proportions of cases that occur in each of the categories with the values that would be expected if there was no association between the two variables being measured. It is based on a cross tabulation table, with cases classified according to the categories in each variable. (p. 217)

The statistical threshold for determining a significant association between independent variables was set at $p < 0.001$, corresponding to alpha = 0.001, and the strength of the association was reported as Cramer's *V*. The results of the chi-square of independence revealed whether there was a difference, before and after the policy change, in the number of high school students who graduated with a GPA eligible for the state's advanced university system requiring GPA > 3.0, with a GPA eligible for the state's standard university system requiring GPA > 2.0, or not eligible for a state 4-year university with GPA below 2.0.

Data Analysis Plan

The first research question was: How do high school GPA scores differ before and after implementing a local curricular policy change? The alternative hypothesis was that there was a statistically significant difference in high school GPA before and after the policy change, while the null hypothesis was that there was no statistically significant difference. I conducted the statistical comparison of high school GPA between cohort groups using SPSS Version 25.0 software (IBM Corp Released, 2017) with an independent samples *t* test, which is ideal for one continuous dependent variable, high school GPA, and for only one categorical independent variable with two groups, Cohort. The alpha was set at 0.001, $p < 0.001$, for determining the significance of difference. A primary assumption of the independent *t* test is that samples in the two different groups are independent of each other. This current study design ensured this because each student belongs to only one of the two different groups (National Student Clearinghouse Research Center, 2018).

The additional assumptions of normally distributed dependent variable and homogeneity of variance across both groups were checked within SPSS based on the Shapiro-Wilks test for normality and Levene's Test of Equality for homogeneity. A log transformation of high school GPA to correct the non-normal distribution was performed as recommended by SPSS in their online tutorial (Rees, 2018). The results from a Mann-Whitney U test, a nonparametric equivalent of the independent samples *t* test which does not assume normality, was also conducted. Levene's Test for Equality of Variances was also conducted to check homogeneity of variance for each cohort group. As homogeneity was violated, I used the "Equal variances not assumed" *t*-test output, based on the Welch-Satterthwaite correction method (Rees, 2018), as recommended by SPSS in their online tutorial. Therefore, the option of "Equal variances not assumed" correction for heterogeneity of variance was used for interpreting *t*-test results.

No correction for multiple comparisons was needed because there was only one *t* test conducted. I interpreted the result of the *t* test based on the *p* value output where $p < 0.001$ indicates a significant difference between groups. I summarized the results of the difference in GPA between prepolicy and postpolicy cohort groups with a table comparing each group's average high school GPA and also with a bar graph including 99% confidence intervals corresponding to alpha = 0.001. I interpreted the size of the effect with *Cohen's d* effect size according to the standard convention where $d=0.20$ indicating a small effect, $d=0.50$ indicating a medium effect, and $d=0.80$ or higher indicating a large effect (Cohen, 1988).

The second research question was: How does college eligibility differ before and after the policy change, as measured by the number of high school students who graduated with a GPA of 3.0 or higher (minimum eligibility for the state's advanced 4-year universities), with a GPA between 2.0 and 2.99 (minimum eligibility for the state's standard 4-year universities), or with a GPA below 2.0 (not eligible for a state 4-year university)? The alternative hypothesis was that there was a statistically significant difference in college eligibility before and after the policy change as measured by the number of high school students who graduated with a GPA of 3.0 or higher (minimum eligibility for the state's advanced 4-year universities), with a GPA between 2.0 and 2.99 (minimum eligibility for the state's standard 4-year universities), or with a GPA below 2.0 (not eligible for a state 4-year university). The null hypothesis was that there was no statistically significant difference in college eligibility before and after the policy change as measured by the number of high school student who graduated with a GPA of 3.0 or higher (minimum eligibility for the state's advanced 4-year universities), with a GPA between 2.0 and 2.99 (minimum eligibility for the state's standard 4-year universities), or with a GPA below 2.0 (not eligible for a state 4-year university).

A chi-square test of independence between the two independent variables, Cohort and College Eligible, addressed the second research question. The dependent variable for the chi-square test of independence was the counts or numbers of high school students who graduated with a GPA within one of the categories of College Eligible either before prepolicy level of Cohort or after postpolicy level of Cohort of the policy change. I conducted the statistical comparison of college eligibility between cohort groups of

prepolicy and postpolicy using SPSS Version 25.0 software (IBM Corp Released, 2017) with a chi-square test of independence with the alpha set at 0.001, $p < 0.001$, for determining the significance of difference, and using Cramer's V to measure the strength of the association. The independent and dependent variables used in the chi-square test of independence met the chi-square test's major assumptions as both independent variables were nominal, the dependent variable was a count variable, all observations were independent, and all cells of the chi-square table had expected counts higher than five.

Threats to Validity

The primary threat to the construct validity and the external validity of this study involved whether the chosen dependent variable of student high school GPA adequately reflected the important construct of college readiness which is the primary topic under investigation. However, this threat is reduced here due to the strong theoretical framework of Conley's college readiness, which identifies high school GPA as one of the most important and comprehensive measures of college readiness (Conley, 2014, 2018). Many quantitative studies have specifically investigated the potential influence of policy changes increasing graduation course requirements on college readiness as measured by high school GPA (Betts et al., 2013; Betts et al., 2016; Domina et al., 2015; Kim et al., 2015; Le et al., 2016; Long et al., 2012; Plunk et al., 2014), further justifying the use of high school GPA as a measure of college readiness in the current study.

There are two threats to the validity of the statistical conclusion drawn from conducting a *t*-test analysis to answer the research question regarding the potential difference in average student high school GPA between prepolicy and postpolicy groups

of the Cohort. The first threat is that any violation of the two major assumptions of independent samples *t* test - normality of the dependent variable, and homogeneity of variance between groups - can invalidate validity by biasing the *t* score and, therefore, the *p* value and conclusions of significance (Rees, 2018). I avoided this threat in this study by checking carefully for violations of these assumptions and taking the appropriate correction methods as described above in the data analysis plan. The second threat was the relatively large sample size of approximately 80,000 students in each group. The sample size yields large degrees of freedom and inflated *t*-score, which can bias the *p* value to be extremely small, thereby making even minimal differences between groups appear to be much larger and more significant than in reality (Rees, 2018). The solution to this potential threat is that I based the importance of the results on not only the *p* value but also the *Cohen's d* effect size, which is not dependent on sample size and estimates the magnitude of any significant group difference found.

Ethical Procedures

All student data from the district's archive were de-identified and assigned pseudo IDs by the district so each student's identity remained completely anonymous. As a result, there was not any personally identifiable information collected that would need to be kept confidential. I cleared all study procedures with the Institutional Review Board before conducting the study. I made sure to follow all IRB protocols strictly for data gathering, use, and analysis. I adhered to the data use agreement and all district requirements for their de-identified data using the procedures described above.

Summary

In the current study, I used an ex post facto quantitative design to investigate how a local policy change potentially related to changes in students' college readiness before and after policy implementation. The population under investigation are the high school students who have already graduated from a local high school district in the western United States. Therefore, the sampling of this study from the archival data of the local district involved specifically only those students who graduated in the selected years before and after policy implementation. The primary aim of this study was to understand how such policy changes for increasing graduation requirements aligning with 4-year public state university eligibility influence potential changes in college readiness. I generalized the results of this study to the larger national population of high school graduates from school districts in other states with graduation policies that mandate the completion of college preparation courses. I operationalized student college readiness with a student high school GPA as the dependent variable. I operationalized the local policy change with Cohort as the independent variable with prepolicy (Graduates of 2013-2015) and postpolicy groups (Graduates of 2016-2018). I used an independent samples *t* test comparing average student high school GPA between the groups before and after policy implementation. I determined the statistical conclusion from the *t* test based on the *p* value for the significance of high school GPA difference between groups as well as *Cohen's d* for estimating an effect size for the potential group difference. I then conducted a chi-square test of independence by categorizing student GPAs into three levels to determine the differences in college eligibility before and after the policy

change. The three levels were the number of high school students who graduated with a GPA eligible for the state's advanced university system (GPA of 3.0 or higher), eligible for the state's standard university system (GPA between 2.0 and 2.99), or not eligible for the state's university system (GPA below 2.0). In Chapter 4 I present the findings of my study, and in Chapter 5 I discuss the conclusions and recommendations.

Chapter 4: Research Findings

In this quantitative ex post facto study, I investigated how a change in local curricular policy might have influenced high school graduates' college readiness as measured by high school GPA. Colleges have used high school GPA as one of the primary predictors of academic performance in college (Westrick et al., 2015). Postsecondary student performance correlates with high school GPA more than college entrance exams such as the ACT (Hiss & Franks, 2014; Hodara & Cox, 2016; Hodara & Lewis, 2017; Westrick et al., 2015). The first research question asked whether there was a difference in high school cumulative GPA scores before and after implementation of a local curricular policy change. For the following analysis and results, GPA refers to the dependent variable of high school grade point average (GPA). Cohort refers to the independent variable of the high school graduates who received a diploma, prepolicy refers to the cohort group of 2013-2015, and postpolicy refers to the cohort group of 2016-2018. The population included high school graduates who received a district diploma between 2013 to 2018 from a local high school district in the Western United States. Graduates who earned a GED or certificate of completion were omitted from the sample. Students with disabilities were also removed from the data set because some of those candidates have modifications and accommodations in the required curriculum. Students with disabilities were outside the scope of this study. To determine if there were any differences in student high school GPA, I compared average GPA between prepolicy and postpolicy cohort groups. Chapter 4 includes three sections to evaluate the findings of this study, data collection and description, assumptions of independent sample *t* tests,

results of the independent samples *t* test, additional analysis with a chi-square test of independence, and a summary. The first section provides a detailed explanation of the data and testing procedures used to determine if there were any statistically significant differences and the effect size. The results section provides a comprehensive description of the results of the independent samples *t* test, the rationale for the additional analysis, and the chi-square test of independence results. The summary highlights the key findings.

Data Collection and Description

I conducted the research using archival data from a local school district's internal student information system. I first submitted a proposal to the district committee for external research review for approval. As the study involved individual-level data, I also developed a data use agreement that was approved by the school district's Office of Data and Accountability Research and Reporting Branch. The data use agreement was submitted with the proposal to the IRB at Walden University. Once I received IRB approval number 05-06-20-0644661 from Walden University, a person in the district Office of Data and Accountability was assigned to pull the data requested. The data included the year of graduation, GPA, and a student pseudo ID. To prepare the data for analysis using SPSS, I added a column and labeled it Cohort. To create two distinct groups, I filtered the spreadsheet by EndYear that identified the graduation year for each student and selected 2013, 2014, and 2015, and labeled them prepolicy in the Cohort column. I then filtered the spreadsheet by EndYear again and chose 2016, 2017, and 2018, and labeled them postpolicy in the Cohort column. The data set consisted of 161,019 graduates between 2013 and 2018 with a GPA between 0 and 4.0.

Findings for Research Question 1

The first research question was: How do high school GPA scores differ before and after implementing a local curricular policy change? The null hypothesis was that there was no statistically significant difference in the high school GPA scores before and after implementing a local curricular policy change. The alternative hypothesis was that there was a statistically significant difference in the high school GPA scores before and after implementing a local curricular policy change. I conducted an independent samples *t* test to investigate this question.

Assumptions of Independent Samples *t* Test

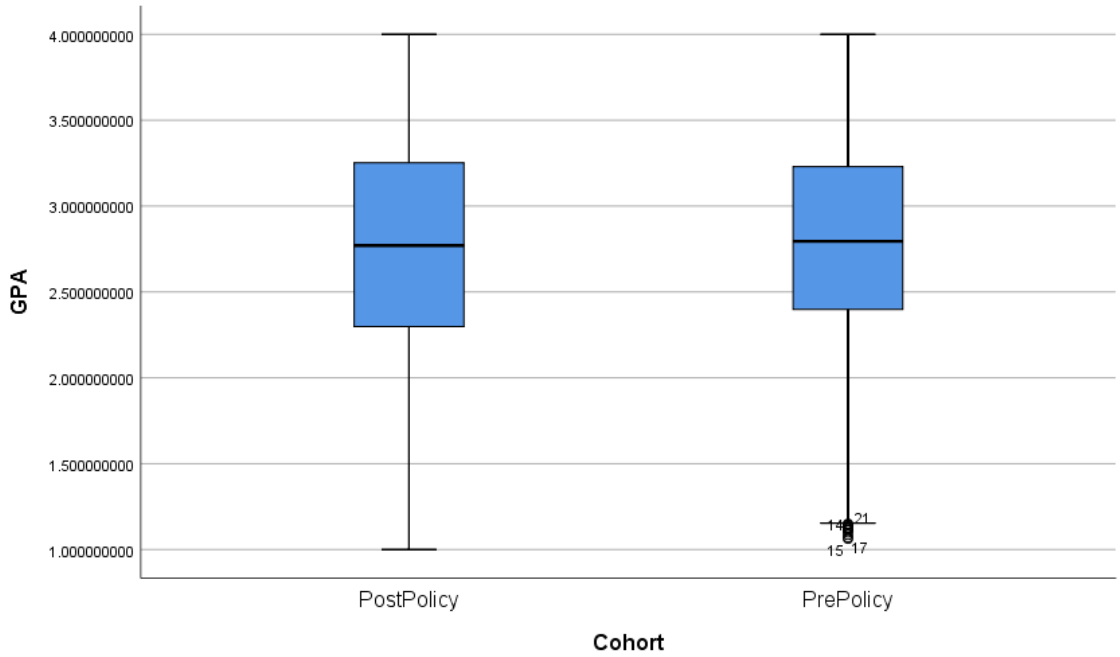
The study design met the first three assumptions of an independent *t* test. The first assumption of one continuous, dependent variable was met with a high school GPA measured from 0 to 4. The second assumption of one independent variable with two categorical and independent groups was met with cohort as the independent variable with two categorical, independent levels of prepolicy and postpolicy. The third assumption of independence of observations was met as students only graduate once, so therefore no relationship exists between the observations within each group of the independent variable.

The fourth assumption of a *t* test is that no significant outliers in either the prepolicy or postpolicy groups. Before checking for outliers in the groups, an initial inspection of the data, separated by graduation year, revealed nine outlier students who graduated from high school with a GPA below a 1.0. Considering this to be an anomaly or entering error and given a small number of cases within the data set, I omitted these

nine students. The final data set then consisted of 161,010 graduates between 2013 and 2018, with an average of 26,835 students per year. In the next step, I graphed a box-and-whiskers plot for each prepolicy and postpolicy group in Figure 1. The four outlier GPA values indicated in the prepolicy group had the following GPA values: 1.06, 1.06, 1.08, 1.09, and 1.11. While a small number of outliers in a very large dataset should not show much bias in the results (Lund & Lund, 2018; Rees, 2018) and are still meaningful for understanding outcomes of high school graduates in the district, the decision was made to not exclude these values. Still, to test for any potential bias, the analyses were also repeated without these outliers, and the results remained nearly identical.

Figure 1

Box and Whiskers Plot for Cohort Groups



Note. This figure demonstrates the box and whiskers graph for each cohort group, pre and post policy as represented as prepolicy and postpolicy. The four significant outlier values are shown in the prepolicy group.

The fifth assumption was that the dependent variable, high school GPA, was approximately normally distributed for each cohort group of prepolicy and postpolicy. This assumption was violated according to a Kolmogorov-Smirnov test of normality provided by SPSS, in the Explore function, for large sample sizes (see Table 1), which indicated that GPA was significantly not normally distributed for both prepolicy ($p < 0.0001$) and postpolicy ($p < 0.0001$) groups. The histograms of the distributions are shown in Figure 2 and Figure 3, displaying negative skew towards low GPA values. According to Rees (2018) and Laerd Statistics (Lund & Lund, 2018), the independent samples *t* test is statistically stable with deviations from normality in very large sample sizes that have approximately equal numbers of samples in each group and also similar skew in each group. This applied to the current dataset: prepolicy ($N = 79{,}194$) and postpolicy ($N = 81{,}816$) had a similar skew (see Figures 2 and 3). To ensure statistical validity, the *t*-test results of the original GPA data were also compared to *t*-test results after log-transform of GPA to correct for nonnormal distribution (Rees, 2018), as well as with results from a Mann-Whitney U test, a nonparametric equivalent of the independent samples *t* test, which does not assume normality.

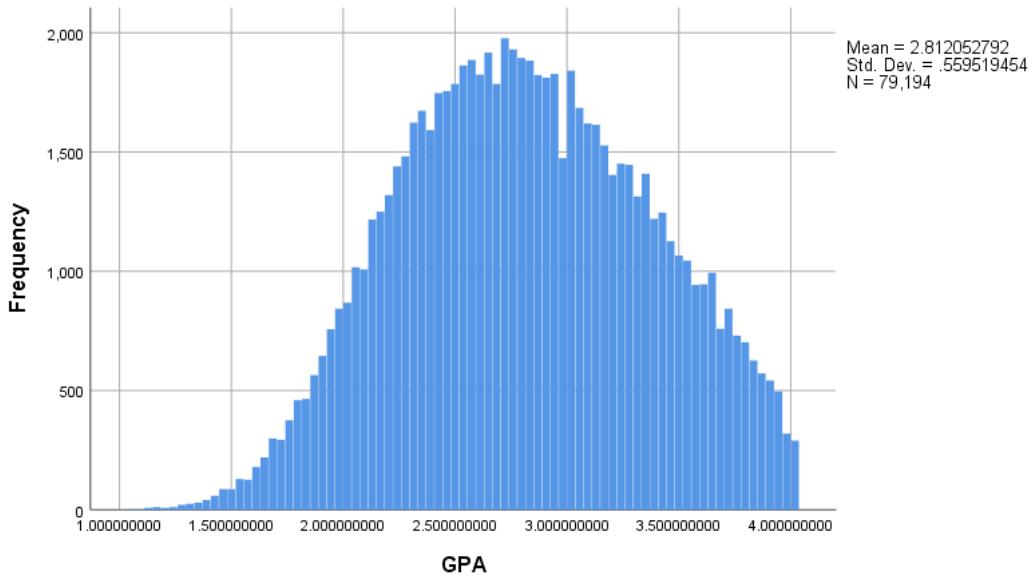
Table 1

Test of Normality

		Kolmogorov-Smirnova		
	Cohort	Statistic	df	Sig.
GPA	postpolicy	.032	81,816	.0001
	prepolicy	.025	79,194	.0001

Figure 2

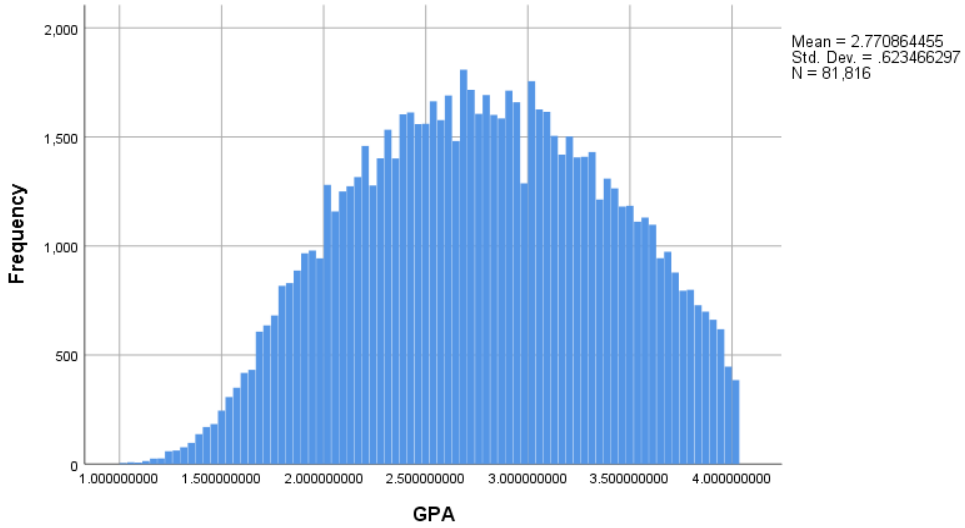
Histogram of Grade Point Average for Prepolicy Cohort



Note. The distribution displays a negative skew towards low GPA values.

Figure 3

Histogram of Grade Point Average for Postpolicy Cohort



Note. The distribution displays a negative skew towards the low GPA values.

The sixth assumption of homogeneity of variance was that the variance of the dependent variable, high school GPA, was approximately the same for each cohort group. According to Levene's test for equality of variances, this assumption was violated (F = 1,273.99, $p < 0.0001$; see Table 3). Therefore, the option of "Equal variances not assumed" correction for heterogeneity of variance was used for interpreting t-test results.

Table 2

Descriptive Statistics of Cohort Groups

Group Statistics

	Cohort	N	Mean	Std. Deviation	Std. Error Mean
GPA	prepolicy	79,194	2.81205279173	.559519453841	.001988241120
	postpolicy	81,816	2.77086445495	.623466296982	.002179685625

Table 3

Results of t Test

Independent Samples Test

		Levene's test for equality of variances		*t* test for Equality of Means						
									99% Confidence Interval of the difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	Lower	Upper
GPA	Equal variances assumed	1,273.99	.000	13.936	161,008	< .0001	.041188336776	.002955460202	.033575485611	.048801187941
	Equal variances not assumed			13.961	160,097.884	< .0001	.041188336776	.002950276627	.033588837261	.048787836290

Results of Independent Samples *t* Test

An independent samples *t* test was conducted to determine if there were differences in average high school GPA between prepolicy and postpolicy cohort groups. Results are shown in Table 2 and Table 3. The null hypothesis of no statistically significant difference in GPA between cohorts was rejected. Average GPA of the prepolicy group (M = 2.81, SD = 0.56) was higher than the average GPA of the postpolicy group (M = 2.77, SD = 0.62), a statistically significant mean difference of 0.04 (99% CI, 0.03 to 0.05), $t(160{,}097.88) = 13.96$, $p < 0.0001$, $d = 0.07$ (99% CI, 0.05 to 0.08). The result was nearly identical with the result from the alternative *t* test of the log-transformed GPA value, to adjust for non-normality, $t(159{,}203.75) = 19.02$, $p < 0.0001$, $d = 0.09$ (99% CI, 0.08 to 0.10). Although the difference was highly significant, the effect size, using *Cohen's d*, was below 0.10, indicating a small effect (Cohen, 1988).

A Mann-Whitney U test, a nonparametric equivalent of the independent samples *t* test, was conducted to assess if the non-normally distributed GPA scores differed between prepolicy and postpolicy cohort groups. The null hypothesis of no statistically significant difference between cohorts was rejected. There was also a significant mean difference of 0.04 (99.9% CI, 0.03 to 0.05), $U = 3.12$, $p < 0.001$. This nearly identical result confirms that the results of the independent samples *t* test were not due to the violation of the normality assumption.

Findings for Research Question 2

According to the *t*-test results reported above, the prepolicy group's average GPA was significantly lower than the average GPA of the postpolicy group. This result is

consistent with a decline in college readiness after the implementation of the new policy. The second research question investigates this issue further.

The second research question was: How does college eligibility differ before and after the policy change, as measured by the number of high school students who graduated with a GPA of 3.0 or higher (minimum eligibility for the state's advanced 4-year universities), with a GPA between 2.0 and 2.99 (minimum eligibility for the state's standard 4-year universities), or with a GPA below 2.0 (not eligible for a state 4-year university)? The alternative hypothesis was that there was a statistically significant difference in college eligibility before and after the policy change as measured by the number of high school students who graduated with a GPA of 3.0 or higher (minimum eligibility for the state's advanced 4-year universities), with a GPA between 2.0 and 2.99 (minimum eligibility for the state's standard 4-year universities), or with a GPA below 2.0 (not eligible for a state 4-year university). The null hypothesis was that there was no statistically significant difference in college eligibility before and after the policy change as measured by the number of high school students who graduated with a GPA of 3.0 or higher (minimum eligibility for the state's advanced 4-year universities), with a GPA between 2.0 and 2.99 (minimum eligibility for the state's standard 4-year universities), or with a GPA below 2.0 (not eligible for a state 4-year university).

Assumptions of Chi-Square Test of Independence

A chi-square test of independence was conducted to test for an association between the independent variables of cohort and college eligible. I used counts of high school students within the different levels of the independent variables as the dependent

variable. The first assumption of nominal independent variables was met. The independent variable of cohort had two categorical, independent levels of prepolicy and postpolicy. The independent variable of college eligible had three categorical, independent levels of high school graduates with GPA > 3.0 eligible for the state's advanced university system (*Uni3.0*), with GPA > 2.0 eligible for the state's standard university system (*Uni2.0*), or not eligible at all (*NO*). The second assumption of independence of observations was also met due to each student only graduating once. The third assumption of all expected cell frequencies higher than five was also met (see Table 4). Post hoc tests of differences between specific levels of the independent variables were assessed with adjusted standardized residuals. Values above two indicate significant relationships, deviations from the null hypothesis of independence, or no relationship, as suggested by Agresti and Franklin (2014).

Results of Chi-Square Test of Independence

The null hypothesis of no statistically significant difference in eligibility rates between prepolicy and postpolicy cohorts was rejected. There was a statistically significant association between Cohort and College Eligible, $\chi^2(2) = 1{,}291.58$, $p < 0.0001$. The effect size or strength of the association, Cramer's V = 0.09, was small (Cohen, 1988). According to the results (see Table 4), the number of students not eligible for college (i.e., the *NO* group) was higher in the postpolicy group (9,968) than in the prepolicy group (5,643), with the adjusted residuals of 34.3 and -34.3, respectively, indicating a significant relation. In other words, after the policy, relatively more students were ineligible for college. For the group that was eligible for the state's standard

university system (i.e., the *Uni2.0* group), the number of students in the postpolicy group (40,762) was lower than in the prepolicy group (43,776), with the adjusted residuals of -21.9 and 21.9, respectively, indicating a significant relation. In other words, after the policy, relatively fewer students were eligible for the state's standard university system. For the group that was eligible for the state's advanced university system (i.e., the *Uni3.0* group), the number of students in the postpolicy group (31,086) was higher than the prepolicy group (29,775), with the adjusted residuals of 1.6 and -1.6, respectively, indicating a non-significant relation. However, there was a trend in that direction. After the policy, relatively more students were eligible for the state's advanced university system, but this difference was not reliable and may have been due to chance. Taken together, these chi-square results are consistent with the *t*-test results that college readiness, as measured by GPA, mostly declined on average after the policy implementation with more students being ineligible for college. However, there was a non-significant trend for some increased college readiness for the highest-GPA group eligible for the state's advanced university system.

Table 4.

Results of Chi-Square Test

CollegeEligible * Cohort Crosstabulation

			Cohort		
			postpolicy	prepolicy	Total
CollegeEligible	Uni2.0	Count	40,762	43,776	84,538
		Expected Count	42,957.3	41,580.7	84,538.0
		% within CollegeEligible	48.2%	51.8%	100.0%
		% within Cohort	49.8%	55.3%	52.5%
		Adjusted Residual	-21.9	21.9	
	NO	Count	9,968	5,643	15,611
		Expected Count	7,932.6	7,678.4	15,611.0
		% within CollegeEligible	63.9%	36.1%	100.0%
		% within Cohort	12.2%	7.1%	9.7%
		Adjusted Residual	34.3	-34.3	
	Uni3.0	Count	31,086	29,775	60,861
		Expected Count	30,926.1	29,934.9	60,861.0
		% within CollegeEligible	51.1%	48.9%	100.0%
		% within Cohort	38.0%	37.6%	37.8%
		Adjusted Residual	1.6	-1.6	
Total		Count	81,816	79,194	161,010
		Expected Count	81,816.0	79,194.0	161,010.0
		% within CollegeEligible	50.8%	49.2%	100.0%
		% within Cohort	100.0%	100.0%	100.0%

Summary of Findings

With this ex post facto study, I investigated how a change in local curricular policy influenced high school graduates' college readiness, as measured by high school GPA. Given the results of the independent samples *t* test, there was a statistically significant mean difference in GPAs between the prepolicy and postpolicy cohorts, such that there was a decline in GPA after the policy implementation. However, the effect size,

using *Cohen's d*, was below 0.10, indicating a small effect (Cohen, 1988). A chi-square test of independence was conducted to determine the differences in college eligibility before and after policy implementation. Given these results, there was a significant association (i.e., $p < 0.0001$) between the cohort and college eligible variables such that there were differences in college eligibility rates across the cohort groups. Fewer students were eligible for the state 4-year university system after the policy change. There was a decrease in the number of students qualifying for the state's standard university system with a GPA of 2.0 to 2.99, and an increase in the number of students not eligible for a 4-year state university with a GPA below 2.0 after the policy change. Finally, although there was a small increase after the policy change in the number of students with a GPA > 3.0 eligible for the state's advanced university system, the difference was small. Overall, from the pattern of results I concluded that the implementation of the new policy in the local district was associated with a decrease in college readiness and eligibility as determined by high school GPA. However, there was some trend-level evidence for an increase in college eligibility for the highest performing students (i.e., with GPA > 3.0). In the next chapter, I present my interpretation, recommendations, and conclusions.

Chapter 5: Discussion, Conclusions, and Recommendations

With this ex post facto study, I investigated how a change in local curricular policy may or may not have influenced high school graduates' college readiness, as measured by high school GPA. The rationale for the local district's new policy was to increase college readiness by increasing course requirements for high school graduation, aligning them with the minimum requirements for state university admissions. This rationale was supported by several previous quantitative studies that found improvements such as increased test scores, better course grades, and higher college enrollment in students who take more rigorous courses (Adelman, 2006; Allensworth et al., 2009; Attewell & Domina, 2008; Byun et al., 2014; Castellano et al., 2017; Gamoran & Hannigan, 2000; Jacob et al., 2016; Kim et al., 2015; Le et al., 2016; Long et al., 2012; Morgan et al., 2018; Wachem et al., 2018). The efforts of the local district to increase college readiness by increasing vertical alignment of academic expectations and curricular rigor between high school and state universities was reflected by several other districts that increased course rigor in California (Betts et al., 2016; Gao, 2016; Philips et al., 2015), North Carolina (Clotfelter et al., 2018), Chicago (Cortes et al., 2015), Florida (Kim et al., 2015), Michigan (Jacob et al., 2016), St. Louis (Le et al., 2016), and the various dual-enrollment or STEM-focused programs and schools (An & Taylor, 2015; Ferguson et al., 2015; Lane et al., 2017; Mean et al., 2016; Saavedra, 2018). The rationale for such policies is supported by previous research where the rigor of high school curricula positively related to academic performance and college outcomes (Ackerman et al., 2013; Bryan et al., 2015; Byun et al., 2014; Conley, 2007; Conley et al., 2014; Jha &

Stearns, 2018; Means et al., 2016; Morgan et al., 2018; Royster et al., 2015; Woods et al., 2018). However, in this current study, the local district's policy change requiring more rigorous courses for high school graduation was associated with a decrease in college readiness as measured by GPA. The current findings are consistent with previous findings of a decrease in high school GPA when mandating a college readiness curriculum for all students (Allensworth et al., 2009; Montgomery & Allensworth, 2010; Preston et al., 2017).

Interpretation of the Findings

High school graduates from the local district completed more rigorous coursework that matched the minimum requirements for college enrollment into 4-year state universities but had a lower qualifying GPA. Despite the improvement in high school graduation requirements, more graduates were not college ready as measured by their high school GPA. The findings add to the body of literature on reform policies to increase college readiness. This research adds information to the gap that exists in the research literature about the efficacy of school districts increasing high school course requirements to improve college readiness, particularly due to a relative dearth of quantitative research studies (Buddin & Croft, 2014; Domina et al., 2015; Jacob et al., 2016; Le et al., 2016; Long et al., 2012; Mazzeo, 2010; Plunk et al., 2014; Preston et al., 2017). This gap in knowledge also relates to a gap in educational practice. Districts and states across the United States have been adopting new reform policies for increasing curricular rigor despite sufficient empirical justification for the efficacy of these policies, particularly for underserved students of different demographics and developmental levels

(Henry & Stahl, 2017). The currently available quantitative research literature on this topic yields a complicated pattern of mixed evidence of positive, negative, or neutral outcomes depending on various factors, including the type of college readiness measure used, previous student achievement levels, and student demographics such as race/ethnicity and economic backgrounds. Notably, the current finding of decreased GPA after the new policy is consistent with previous quantitative reports of policy-related decreases in GPA or grades (Allensworth et al., 2009; Mazzeo, 2010; Montgomery & Allensworth, 2010; Preston et al., 2017).

It seems paradoxical that a graduation policy specifically designed to increase college readiness can often have the opposite effect of decreasing college readiness. However, increasing course rigor can be very challenging, as expected, for many high school students. As a result, grades and GPA may suffer as a result of such requirements, particularly if these students were already struggling with their academic performance. Jacob et al. (2016) suspected that the decreased graduation rates of students who entered high school with the lowest performance "was caused by higher failure rates among low performing students pushed into more difficult courses by the new requirement" (p. 33). In contrast, they also found that the highest performing students showed the more positive gains. This result is similar to the result of the current study in the chi-square analysis where there was a nonsignificant numerical increase in the number of postpolicy students, compared to prepolicy students, who graduated at the highest eligibility level with a GPA > 3.0. So although the new policy reform was associated with decreased college readiness outcomes for most students, perhaps it did positively affect some

students who were already high performing. It is possible that these students were already taking the advanced courses mandated by the new policy. However, this information was not available for the current study, therefore future research is necessary to investigate this issue more completely.

Similar to the current study, Buddin and Croft (2014) found no beneficial effects, and even some adverse effects such as decreased test scores, for the low-performing students. Mazzeo (2010) reported lower grades and higher failure rates in math and English for the lowest-performing students, as well as no increase in college enrollment or persistence for the highest-performing students. Clotfelter et al. (2018) showed that increased college enrollment rates after a new policy were highest for the students already performing highly. Betts et al. (2013, 2016) found some positive outcomes for increased course completion, especially for lowest-performing students, and increased grades in the new courses, but with no effect on GPA. However, they also found little increase in college eligible graduates after the policy implementation, as well as postpolicy decreases in course completion and graduation rates, particularly for demographic groups of Hispanic, African American, and English learners.

Betts et al. (2016) noted that "there could be unintended negative consequences that harm the very students the policy seeks to assist" (p. 18). Betts et al. (2016) posited that many students faced "double jeopardy" (p. 13) needing to not only complete the new courses but also increase their GPAs. This double jeopardy problem may have also affected the local district students under investigation by the current study, given the result of the postpolicy cohort's decrease in average GPA. According to the chi-square

analysis, there was a significant increase in the number of students graduating with a GPA below 2.0 and the number of students who were ineligible for state 4-year universities. At the same time, there was a statistical trend for slightly more students to graduate eligible for the state's advanced university system (i.e., GPA > 3.0, the Uni3.0 group). Although not conclusive, this pattern of results is consistent with the notion of double jeopardy and the imbalanced policy outcomes of increased course rigor that disadvantage the lower performing students while enhancing outcomes for the already high achieving students. For my study, this possibility remains speculative because the study was not designed to address this question. Future analysis could be conducted similar to previous studies (Betts et al., 2016; Buddin & Croft, 2014; Jacob et al., 2016), for example, by including additional variables of students' achievement levels in earlier grades to separate low from high performing students.

Jacob et al. (2016) suggested that because mandating more rigorous courses can unfairly impede the already low-performing students, policies that focus only on increasing course requirements may be insufficient to enhance academic achievement and college readiness. As demonstrated in previous studies and in the current analysis, policies focusing on increased course rigor are often associated with decreased college readiness as measured by decreased academic performance, as reflected in grades and GPA. Although this remains a complicated issue with no clear solutions yet, it seems likely that future policies may need to avoid the "double jeopardy" problem to maximize college readiness. The previous policy of providing students' a choice of different levels of rigorous courses instead of requiring all students to take college preparatory courses

led to disparities in access and educational experiences within schools and across the district. Additional policy change efforts may need to accompany new policies that mandate the completion of rigorous college preparatory curriculum for all, such as improving instruction, increasing intervention resources, and implementing a mastery-based learning educational approach to promote a growth mindset and enhanced learning in the more challenging courses. As GPA is one of the most reliable indicators of college readiness, the result of a postpolicy decline in GPA implies that college readiness also decreased.

This study was grounded in Conley's theory of college readiness. Conley defined college readiness along multiple dimensions reflected in the Four Keys relating to cognitive ability (Key 1: "think"), knowledge (Key 2: "know"), academic behaviors (Key 3: "act"), and college-going orientation (Key 4: "go"). Conley described GPA as a multidimensional concept that reflects content knowledge, academic performance, and “a whole series of metacognitive learning skills such as time management, study skills, help-seeking strategies, persistence, and goal focus" (Conley, 2014, p. 14). Conley (2014) posited that high school GPA is one of the strongest predictors of college success. Previous studies have demonstrated that high school GPA can be a more informative indicator of college enrollment and success than standardized test scores (Allensworth & Clark, 2020; Hiss & Franks, 2014; Hodara & Cox, 2016; Hodara & Lewis, 2017; Westrick et al., 2015) or other school-related variables such as advanced-course taking (Warren & Goins, 2019). Several previous studies have also used high school GPA as a measure of college readiness for assessing the potential efficacy of graduation policies for

increased course rigor (Betts et al., 2016; Le et al., 2016; Preston et al., 2017). Like Conley (2014), Mattern et al. (2014) also stated that high school GPA not only reflects student academic achievement but also reveals noncognitive aspects of study habits, organization, self-regulation, grit, and motivation. Each of these plays an integral role in college readiness and postsecondary success. Finally, a consensus has emerged in the experimental and theoretical literature regarding the importance and usefulness of high school GPA as an indicator of college readiness with which to assess the potential influence of new curricular or graduation policies (Allensworth & Clark, 2020; Bryan et al., 2015; Conley, 2017; Perusse et al., 2015).

The present finding of decreased GPA after the new policy may indicate that the new policy was associated with detrimental changes to student performance in the more rigorous courses and students' general orientation towards learning. For example, the increased course difficulty may have reduced students' confidence in themselves for those whose performance was impaired, thereby potentially reducing their motivation or aspirations for further achievement in high school or college (Mattern et al., 2014; Phillips et al., 2015). However, this remains speculative because the current study did not include any additional variables in the analysis such as student motivation, aspirations, and learning supports to investigate these potentially extended effects of the new policy.

While GPA is a reliable marker of college readiness, it is clear from Conley's theoretical framework that college readiness is a multidimensional issue that may not be easily captured by a single metric such as GPA. Conley (2003) discussed the difficulties in producing a universal definition of college readiness and suggested using multiple

measures to capture the multifaceted concept. Jackson and Kurlaender (2014) also emphasized the challenges in defining college readiness and referred to it as a "nebulous term" (p. 955). Many colleges and universities typically rely on multiple measures such as high school courses taken, GPA, and test scores to assess students' potential college readiness. Moreover, many but not all previous quantitative assessments of policy outcomes from increased course rigor have also used more than one measure of college readiness (Betts et al., 2016; Buddin & Croft, 2014; Mazzeo, 2010; Preston et al., 2017). Klasik and Strayhorn (2018) also demonstrated that the college readiness of a student, given their specific GPA or test scores, also critically depends on their race/ethnicity background and the selectivity of the school to which they apply. The researchers recommended that GPA should not be used alone as a dichotomous variable indicating college ready or not ready but should be used with these other variables to represent a continuous spectrum of potential for college readiness. Therefore, it is essential to emphasize that although GPA may capture a significant degree of what it means to be college ready, other measures may complement the GPA to provide a fuller picture of college readiness (Allen et al., 2019). Regardless, the present study provides important new evidence to the ongoing debate surrounding the potential efficacy of graduation policies for increasing course rigor by mandating a college readiness curriculum.

Limitations of the Study

There are some limitations to this study. First, in this study I focused on how a change in local curricular policy influenced high school graduates' college readiness as measured by high school GPA. In this study I did not explore the impact of the increased

course requirements on high school graduation or dropout rates, and I did not examine the changes in 4-year college enrollment and persistence. The study had a limited focus on the difference in student GPA as the indicator of college readiness and eligibility to 4-year state universities. Policy changes have the potential to influence multiple outcomes for students. Many previous quantitative studies of policy changes have utilized more than one outcome variable to assess changes in college readiness. Nevertheless, there is a growing consensus from the theoretical and research literature that high school GPA provides one of the best measures to capture college readiness (Allensworth & Clark, 2019, 2020). With the design of this study, I maximized simplicity and optimized construct validity; therefore, college readiness was defined with only a single measure of high school GPA. However, construct validity would be further enhanced by including additional measures of college readiness such as college aspirations, college enrollment, or persistence.

Second, students with disabilities were excluded from the study sample since those graduates have curricular modifications and accommodations that would complicate any combined analysis. The results from this study, therefore, do not generalize to that student population. Future work will be necessary to understand how new policies for increasing course rigor may be associated with changes in the college readiness of students with disabilities. It is possible that such policies would inadvertently increase the double jeopardy risk for these students who may already be sufficiently challenged by the traditional curriculum. It would be important to assess this issue more thoroughly to advise current educational practice.

A third limitation is that this study design did not control for additional variables that might confound the relation between the policy change and college readiness changes as measured by high school GPA. Such potentially confounding variables include student demographics such as race/ethnicity, income or socioeconomic status, students' prior academic performance such as grades in early high school or end of middle school, students' level of motivation and aspirations, and variation in school size and types. Many previous quantitative studies on similar graduation policy changes have controlled for one or more of these potentially confounding variables, although with more sophisticated statistical analysis methods (Jacob et al., 2016; Kim et al., 2015; Long et al., 2012; Plunk et al., 2014; Royster et al., 2015; Woods et al., 2018). Therefore, these potentially confounding variables may influence some proportion of the changes in high school GPA.

A fourth limitation is that some of the statistical assumptions of the *t*-test analysis were violated. The violations of non-normal distribution and heterogeneity of GPA as the dependent variable could have potentially biased the *t*-test results. However, appropriate statistical procedures were conducted to resolve these assumption violations, and so it is unlikely that the results were biased by these issues.

Finally, and perhaps most importantly, because this quasi-experimental study used an ex post facto design, none of the findings from this study can be interpreted in terms of cause-effect relations. In other words, I could not determine whether the observed changes in high school GPA were caused by the new policy itself. A quasi-experimental study that does not experimentally manipulate the independent variable or

randomly assign students to different conditions cannot adequately assess causality (Barnighausen et al., 2017; Leiber et al., 2015; Reio, 2016). Some quasi-experimental studies investigating policy outcomes use sophisticated quantitative procedures such as traditional multiple regression (Rivkin & Schiman, 2015; Woods et al., 2018) or more advanced regression procedures such as instrumental variable modeling (Clotfelter et al., 2018; Kim et al., 2015), regression discontinuity analysis (Cortes et al., 2015), or propensity score matching and sensitivity analysis (e.g., Byun et al., 2014; Long et al., 2012) to test for relations between numerous interacting variables. The purpose of these quasi-experimental studies was to infer potentially causal relationships in the effect of a new policy on college readiness outcomes. However, it is important to note that these statistical procedures still enable only indirect, instead of direct, tests of causality because the studies were quasi-experimental in nature. With the current study, I examined the GPA of graduates in prepolicy and postpolicy cohort groups, so a quasi-experimental ex post facto design was appropriate. Therefore, it is important to emphasize that although the observed changes in high school GPA associated with the new policy implementation are consistent with a potential cause-effect relation, such causality cannot be concluded. Future research with fully experimental designs will be necessary for investigating whether such policy changes can indeed cause changes in college readiness.

Recommendations

A strength of the current study is the large sample taken from a large urban school district that struggles with low rates of college readiness and so provides representation and serves as a test case of the national problem. Future research studies on this topic

would also benefit from similarly large sample sizes from equally representative school districts to better generalize findings for the larger population of students struggling with college readiness. It would also be interesting to see how the current results from a large district compare to results from other large districts, as well as how results may differ between large and small districts. Future studies would also benefit from also including high school GPA as a quantitative measure of college readiness, given that this measure is well grounded in the theoretical and research literature. Given the importance of student GPA, it is warranted for policymakers to consider including a minimum GPA to accompany the college preparatory course mandate. It is clear from the findings that students completed the more rigorous course requirements for graduation but fell short in attaining a college eligible GPA.

As mentioned earlier, similar to some previous studies (e.g., Jacob et al., 2016), in this study I also discovered some preliminary evidence for potentially positive results of increased college eligibility for the highest performing students with GPA > 3.0. It is possible that differences in the type or quality of course content and instruction may have influenced different student outcomes depending on which new courses were selected by different students to fulfill their graduation requirements. Another possibility is that these higher performing students preferentially benefitted from including these new courses in their curriculum. It is also possible that these students were already taking the advanced courses before the policy implementation because many students in previous years have done so in order to be competitive by going beyond the basic requirements of the college prep curriculum. Although these possibilities remain speculative in the current study, due

to insufficient information provided in the dataset, future research would be necessary to investigate these issues more completely so that new policies can optimize the quality of the newly mandated courses for as many students as possible. For example, it would be interesting to focus on college readiness outcomes of the group of students who are highly competitive and taking advanced courses beyond even the newly mandated college prep curriculum.

As demonstrated in the literature review, many quantitative studies on the topic of policy change for improving college readiness have been only quasi-experimental instead of truly experimental because they did not manipulate the policy change or assignment of students. Such experimental procedures may be complicated, if not impossible, or even unethical to do in many educational contexts. However, because students' futures and the nation's economy may very well depend on improving college readiness, it is vitally important that researchers rigorously test policies with causal experimental designs to determine the impact on student outcomes. Such causal design studies would also benefit from controlling for potentially confounding variables from the student, teacher, and school levels to clarify the specific causal relationships between the policy change and student outcomes. Future causal design studies would also benefit from analyzing multiple outcome measures of college readiness, including high school GPA, for capturing as much variability of college readiness as possible. Future studies may also help to clarify the specific casual relations between policy change and different aspects of college readiness.

Implications

Past researchers have shown that rigor of high school curricula relates to college enrollment, persistence, and completion (Ackerman et al., 2013; Bryan et al., 2015; Byun et al., 2014; Conley, 2007; Conley et al., 2014; Jha & Stearns, 2018; Means et al., 2016; Morgan et al., 2018; Royster et al., 2015; Woods et al., 2018). As state policymakers, school district leaders, and universities seek to improve college readiness, many have increasingly turned to increase course requirements for all students. This study offers insights into the impact of such policy changes in a large urban school district. While the policy change was associated with reduced inequities in access to a rigorous college preparatory curriculum, the current results are consistent with the idea that increasing course requirements alone does not substantially increase college readiness and college access. Although I did not explore the college preparatory curriculum's efficacy in this study, there is the possibility that, with the expansion of rigorous course offerings, there may be some dilution of course content and rigor. Course dilution is an unintended consequence of mandating college preparatory courses as found by Buddin and Croft (2014) and Dougherty et al. (2006). Also, according to the chi-square analysis findings, there may have been a detrimental impact on the vulnerable and struggling students. Further research is needed to identify the effect on different student groups by race/ethnicity and language acquisition, such as English learners.

Despite all students completing the courses necessary for 4-year state university admissions, the policy change did not appear to fulfill the aspirations of those policymakers who supported increasing course requirements for all students in order to

increase college readiness and college access. The policy also seemed to make it difficult for students with college aspirations to distinguish themselves from their classmates. Despite disappointing results, with this study I have added support to the importance of college readiness's multidimensional nature as no single reform adequately improves college access. For the changes in graduation course requirements to have their intended impact, they possibly needed to be accompanied by additional instruction, interventions aimed at enhancing academic behaviors, and increasing college knowledge as reinforced in Conley's college readiness framework.

Conclusion

While the positive social change intent of those making the policy change was laudable, increasing course requirements for graduation alone did not serve as a mechanism to improve college and career readiness. In this study, I found that the new policy mandating more rigorous course requirements did not increase but rather decreased college readiness as measured by graduate GPA. Increasing student access to a college preparatory curriculum may need to be accompanied by improved instruction, increased intervention, and better support to build college knowledge with college advisement. Given the trends to increase high school course requirements among districts, states, and universities, further research is needed to understand how such changes impact student outcomes such as college access, persistence, and completion.

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