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UNIVERSITY OF NORTHERN COLORADO

Greeley, Colorado

The Graduate School

IDENTIFYING EARLY WARNING INDICATORS FOR  
IMPROVED HIGH SCHOOL OUTCOMES  
FOR STUDENTS

A Dissertation Submitted in Partial Fulfillment  
of the Requirements for the Degree of  
Doctor of Education

Dina Perfetti-Deany

College of Education and Behavioral Sciences  
Department of Leadership, Policy, and Development:  
Higher Education and P-12 Education  
Program of Educational Leadership and Policy Studies

August 2021

This Dissertation by: Dina Perfetti-Deany

Entitled: *Identifying Early Warning Indicators for Improved High School Outcomes for Students.*

has been approved as meeting the requirement for the Degree of Doctor of Education in the College of Education and Behavior Sciences in the Department of Leadership, Policy, and Development: Higher Education and P-12 Education, Program of Educational Leadership and Policy Studies.

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Date of Dissertation Defense: June 28, 2021

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## ABSTRACT

Perfetti-Deany, Dina. *Identifying Early Warning Indicators for Improved High School Outcomes for Students*. Published Doctor of Education dissertation, University of Northern Colorado, 2021.

Over the last 100 years, the overwhelming majority of Americans have attended this nation's public schools. There are clearly documented deleterious effects for students who do not successfully graduate from high school. Further, scholars and practitioners have recognized the adverse impacts on communities and the economy. Unfortunately, Colorado youth persistently have graduated at lower rates than the national average. The information yielded from this study can assist school leaders who wish to identify middle school students at risk of not graduating on time in order to provide an intervention that will set them on a path to graduation.

This study provides an extensive secondary data analysis of a cohort of 1,268 students, following them from sixth grade through their high school outcomes. A binomial logistic regression approach was used to test individual performance factors for their correlation to the outcomes of graduating on time, dropping out, and being on track to graduate at the end of the ninth grade, including core subject grade point average, chronic absence status, and the number of disciplinary incidents students experienced in each middle school year, sixth through eight. The moderation effect of student background factors was examined to determine their moderation effect on individual performance factors for each of the three outcomes. The variables studied were gender, free and reduced-price lunch status, race and ethnicity, disability status, and English language learner status. Three logistic regression models were tested, one for

each grade level (sixth, seventh, and eighth), and this was repeated for each of the three outcome variables.

The logistic regression models yielded significant results related to dropout status, graduating on time, and being on track in ninth grade. When the unique predictive value of core GPA, number of disciplinary incidents, and chronic absence status were analyzed within the models, core GPA was the single most significant variable. In the sixth grade, the number of disciplinary incidents experienced by students was also significantly associated with the odds of graduating on time. For the dropout status outcome, the background variable of race and ethnicity moderated the results favorably for students identified as White and less favorably for students identified as Hispanic or Latino. For the outcome of graduating on time, students identified as White benefited more than their non-White peers when their absences changed from chronic (absent 17 or more days of school) to non-chronic (absent less than 17 days of school) in sixth and eighth grades. Regarding the outcome of being on track at the end of the ninth grade, students identified as having a disability benefited more than their peers when their core GPA increased by a letter grade at all three grade levels.

The implications of the findings from this study can provide specific guidance for school leaders in settings similar in size and demographics regarding which early warning indicators best predict the dependent variables of the study. Furthermore, school leaders can use the specific information about how each year of middle school is correlated with the early warning indicators, signaling that a student is off track for graduating on time and needs support and intervention. This study can positively impact students by increasing the likelihood they are identified for and receive targeted support that sets them on a path to graduate from high school on time, resulting in lifetime benefits for students, communities, and the economy at large.

## ACKNOWLEDGMENTS

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Thank you to my committee chair, Dr. Linda Vogel, and my committee members, Dr. Michael Cohen, Dr. Randy Zila, and Dr. Chia-Lin Tsai. I am deeply appreciative of their thoughtful feedback and support. I also want to recognize Dr. Tsai for the additional time she spent with me to ensure my statistical analysis was accurate. She made it possible for me to pursue this quantitative study.

I cannot imagine a more rewarding, important career than one in public education. I have met phenomenal people who have dedicated their lives to creating a stronger, more civil society by ensuring our public education system is a place where every single student receives an outstanding education that inspires and enables them to follow their dreams. I pursued this

degree to expand my knowledge and contribute to our collective work in the best way possible for our children and youth. I am honored to work alongside so many with similar values.



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## CHAPTER I

### INTRODUCTION

Outside of parenting, it is difficult to imagine another institution more essential to society than public education. In 2017, 94.4% of children ages five to 17 living in the United States were enrolled in a public school (National Center for Education Statistics [NCES], n.d., Table 201.10). The first time this percentage topped 90% was during the 1989–90 school year, and the last time less than 80% of our nation’s children ages five to 17 were enrolled in public schools was almost 100 years ago, the school year 1919–20 (NCES, n.d., Table 201.10). U.S. Census records dating back to the 1869–70 school year reflect that this percentage never dipped below 64% following 1870 (NCES, n.d., Table 201.10). These figures reveal that the overwhelming majority of Americans attended this nation’s public schools over the last 100 years. Notably, several studies discussed in the literature review connect the level of success our youth experience in school to societal impacts.

National measures of the success of public schools include the national graduation rate, which has steadily increased over time, and the dropout rate, which has steadily declined (NCES, n.d.). Yet inequities in education persist (NCES, n.d.; Noguera et al., 2015). Today’s students become members of society, so when inequities in education persist, those effects are felt by all (National Research Council, 2011). Community safety, local services, and the economy are significantly shaped by the work occurring daily in public schools (Christeson et al., 2008; Lansford et al., 2016; Muennig et al., 2005). An examination of graduation and dropout rates in a local context would reveal inequities and enable local leaders to formulate responses. While

national, state, and local levels of authority over schools have evolved over the years, educational leaders maintain the authority and responsibility to identify students at risk of dropping out and provide interventions to help more students graduate from high school.

Public education was founded on the principle of local control of schools, and schools have continued to fill significant social and symbolic roles in local communities (Brown, 2010; Cohen-Vogel et al., 2010; Marcouyeux & Fleury-Bahi, 2011; Warren, 2005). A recent review revealed a trend of reduced local control between 1994 and 2001, with a slight shift back to local control in 2001 (Hess & Eden, 2017). Relatedly, the historical context sheds light on the evolving role of national and state governments in monitoring graduation and dropout rates for U.S. public schools.

Despite the acknowledgment of their importance, a seminal report, *A Nation at Risk*, was published by the National Commission for Excellence in Education, stating that local schools were responsible for “the rising tide of mediocrity” in the United States (Gardner, 1983, p. 7). The 2001 reauthorization of the Elementary and Secondary Education Act (ESEA, 2001) shifted the emphasis of accountability mandates, assessment systems, and disciplinary efforts to achieve high expectations from the state to the federal level, directed by the U.S. Department of Education (Hess & Eden, 2017). A series of federal legislative acts and reports followed *A Nation at Risk*, including Goals 2000 (1994), the Reading Excellence Act (2001), the Education Sciences Reform Act (2001), the No Child Left Behind Act (2001), and Race to the Top (2009), and all attempted to bring uniformity in expectations and practice to schools across the country (Schafft & Biddle, 2013).

Race to the Top (RTTT) was a competitive federal grant program funded as part of the American Recovery and Reinvestment Act (2009). Onosko (2011) depicted RTTT as a

“profoundly flawed national education reform plan” supported by interest groups committed to educational equity through centralized federal control (p. 2). States and, to a lesser extent, local entities competed for multi-million dollar grants to implement national high-stakes testing and accountability, national standards, and teacher and administrator evaluations and removals based in part on student performance on standardized tests; this led in part to the greater privatization of public education through the expansion of charter schools (Onosko, 2011). State and local entities retained the individual choice to compete for RTTT grant dollars, reflecting a slight shift toward more local control when compared to the effects of NCLB. The subsequent reauthorization, named the Every Student Succeeds Act (ESSA), was passed in 2015 and redirected the authority to determine accountability and assessment systems back to the states (Hess & Eden, 2017).

Schafft and Biddle (2013) pointed out the juxtaposition of the obligation for educational leaders to be responsive to local needs and issues while also functioning as institutions of the state, beholden to state and national mandates. Consequently, individual districts found themselves restricted by federal and state-level directives, but they also had local data and politics to manage (Schafft & Biddle, 2013). Local school district leaders were left to examine the performance of their school district relative to national, state, and local performance indicators.

### **Graduation Policies and Reporting**

Similar to education policies, graduation policies and the reporting of graduation rates have evolved over time. The federal government shifted states to a more uniform method of defining and reporting graduation rates in 2010–11 (NCES, n.d.). Prior to that year, the methods

for calculating graduation rates varied by state (NCES, n.d.). Additionally, the graduating cohort of students was calculated differently across states prior to the 2010–11 school year (Belfield & Levin, 2007).

The adjusted cohort graduation rate (ACGR) was first measured throughout the United States in the 2010–11 school year, and its adoption by all states provided more uniformity in national reporting on academic standards. The ACGR reflects the percentage of high school freshmen who graduated with a regular diploma within four years of starting the ninth grade (NCES, n.d.). The percentage of the adjusted cohort of students who graduated within four years of entering the ninth grade represents the “graduation rate” and reflects “on-time graduation” (NCES, n.d.). However, the Bureau of Indian Education and Puerto Rico were not included in the U.S. average ACGR (NCES, n.d.). Nationally recognized racial categories excluded Hispanic ethnicity as a category for the initial assessment year; thus, the graduation rate of Hispanic students could not be identified at that time (NCES, n.d.). Any analysis of graduation data from the years prior to the institution of ACGR must consider these inconsistencies when calculating graduation rates. For example, between the 1989–90 and 2010–11 school years, the reported number of graduates included all students who had obtained a high school diploma, regardless of whether it took four, five, six, or seven years (NCES, n.d.).

The average freshman graduation rate (AFGR) was another method applied to calculate the graduation rate (NCES, n.d.). The less utilized AFGR was calculated by averaging enrollment in the eighth, ninth, and tenth grades to yield an estimated ninth-grade count. That estimate was compared to the number of graduates four years later (NCES, n.d.). Both the



ACGR and the AFGR were reported as comparable, but the AFGR was described as less accurate and used less frequently (NCES, n.d.). For this reason, the ACGR was used as the calculus for the graduation rates used in this study.

Once a uniform ACGR was instituted throughout the U.S., it was possible to demonstrate that the U.S. high school graduation rate increased incrementally from 79% in 2011 to 85% in 2018 (NCES, n.d.). While these data reveal a positive, steady trajectory between 2011 and 2018, disaggregated data by race and ethnicity demonstrated a continued gap of as much as 11% between the graduation rates of students who identified as White and racial and ethnic minority students nationally (NCES, n.d.). Colorado graduation rates also increased during this period but still fell below national rates.

The adoption of the national ACGR measurement by Colorado schools resulted in the reporting of three-year through seven-year graduation rates (CDE, n.d.). Concurrently, Colorado began reporting more comprehensive data, including students who graduated from high school regardless of the number of years it took, students who obtained a General Education Development (GED) credential, and students who obtained a non-diploma certificate (CDE, n.d.). Colorado graduation rates gradually increased from 2011 through 2019, although the state lagged behind the national average (NCES, n.d.).

It is important to note that graduation rates are one of two historically measured indicators of school success. The dropout rate was another measure of school success, and it was commonly reported in conjunction with graduation rates at the national and state levels. According to NCES (n.d.), a student would be classified as a dropout if they had not earned a high school credential between the ages of 16 and 24 years and were not currently enrolled in high school. Some students successfully completed high school or the equivalent through other

means (e.g., GED) and thus were not considered dropouts. For this reason, it is helpful to examine dropout rates alongside graduation rates since a change in one may not have resulted in a change to the other depending on the definition of the term “graduate.” For example, students who graduated in five to seven years lowered the four-year graduation rate and positively impacted the dropout rate (CDE, n.d.; NCES, n.d.). However, a student who obtained a GED certificate lowered the graduation rate and the dropout rate (CDE, n.d.; NCES, n.d.). Further, students who emigrated to another country prior to finishing high school were not counted in either the graduation rate or the dropout rate (CDE, n.d.; NCES, n.d.). These data clarify it is critical to understand who is included in graduation rates and dropout rates when studying this topic in order to develop a complete picture of school success.

While the adoption of the ACGR created increased consistency across states in reporting graduation rates, states handled the adoption of graduation requirements differently (NCES, n.d.). For example, the NCES (n.d.) reported that, in 2013, the high school credit requirements for graduation by state varied from 13 total Carnegie units to 24 Carnegie units, and three states, including Colorado, left those decisions to individual school districts. A Carnegie unit is defined as a standard measurement used by most school districts nationally, where one credit is granted for the completion of a one-year course (NCES, n.d.). States also varied widely in what was required for graduation outside of the total number of course credits. The disparity in the number of math credits required in 2013 ranged from 2.0 to 4.0, and some states required passing scores on exit exams (NCES, n.d.).

For the current study, the researcher was interested in examining dropout rates and graduation rates (ACGR). Unless specified otherwise, “graduation rate” refers to the four-year or on-time ACGR, and “graduate” is defined as a student who graduated within four years and was

thus included in the ACGR. Those two data points illustrate the most favorable and unfavorable outcomes for high school students, though it is acknowledged that some students have school outcomes not represented by either term.

### **Dropout and Graduation Rates**

This study aimed to improve high school outcomes for all students and eliminate disparities among students regarding the successful completion of high school. A closer examination of dropout and graduation rates disaggregated in various ways revealed unequal levels of success between some specific groups of students at the national level and in Colorado, where this study was conducted (CDE, n.d.; NCES, n.d.). In this section, the national and Colorado dropout and graduation statistics are described for the general population of students, as well as other student background factors such as race and ethnicity, disability status, English language status, and socioeconomic status. Discovering how students performed nationally and locally in terms of both measures revealed the need for this study.

The most recent national student enrollment data for the United States was released for the year 2017, when the race and ethnic distribution in public schools (preschool through 12<sup>th</sup> grade) was 47.6% White, 15.2% Black, 26.7% Hispanic, 5.2% Asian, 0.4% Pacific Islander, 1% American Indian and Alaska Native, and 3.9% two or more races (NCES, n.d.). The most recently reported national dropout rates, from 2018, totaled 5.3%, with 4.2% White, 6.4% Black, 8.0% Hispanic, 1.9% Asian, 8.1% Pacific Islander, 9.5% American Indian and Alaska Native, and 5.2% two or more races (NCES, n.d.). The national dropout rate incrementally decreased between 2006 and 2018, and all racial and ethnic groups of students experienced decreased dropout rates except for students identified as Pacific Islanders or two or more races (NCES, n.d.). These data show a generally positive trend for U.S. public schools. Males dropped out at a

rate of 6.2%, and for females, that figure was 4.4% (NCES, n.d.). Additionally, dropout information for students with a disability was 11.7% (NCES, n.d.). The dropout rate was 16.6% for students who spoke another language at home and whose English was assessed as less than proficient (NCES, n.d.).

The most recent national graduation rates from 2018 can also be disaggregated by a variety of student background factors, including race and ethnicity, although not in precisely the same categories as dropout rates (NCES, n.d.). The 2018 graduation rates totaled 85%; broken down by race and ethnicity, the data shows 89% White, 79% Black, 81% Hispanic, 92% Asian and Pacific Islander, and 74% Native American and Alaska Native (NCES, n.d.). These data demonstrate that students who identified as White or Asian graduated from high school at higher rates and dropped out at lower rates than all other races (NCES, n.d.). Economically disadvantaged students had a graduation rate in 2018 of 80% (NCES, n.d.). The graduation rate in that same year for students with disabilities was 67%, and it was 68% for students with limited English language proficiency (NCES, n.d.). NCES (n.d.) discontinued reporting graduation rates by gender in 1984. Consequently, the examination of graduation rates by race and ethnicity, English language proficiency level, socioeconomic status, and disability status revealed more information about how students fared nationally in public schools.

Student enrollment data for Colorado was most recently reported in 2019 by the Colorado Department of Education (CDE, n.d.). In 2019, the student enrollment in preschool through 12<sup>th</sup> grade in Colorado public schools was 53.4% White, 4.4% Black and African American, 33.6% Hispanic and Latino, 3.2% Asian, 0.3% Native Hawaiian and Other Pacific Islander, and 0.7% American Indian and Alaska Native (CDE, n.d.). The state graduation rate increased from 79% in 2017 to 81.1% in 2019 (CDE, n.d.). Colorado 2019 graduation rates examined by student race

and ethnicity were reported in slightly different categories than pupil enrollment categories. The rates were recorded among student groups as follows: 85.9% White, 74.4% Black and African American, 74% Hispanic or Latino, 89.9% Asian or Pacific Islander, and 64.9% Native American or Alaska Native (CDE, n.d.). In 2019, the graduation rate for students with disabilities was 59.2%; for limited English proficiency, it was 68.6%; and among economically disadvantaged students, the rate was 70.8%. All three categories declined over the four years preceding 2019 (CDE, n.d.). In each of these categories except limited English proficiency, Colorado students underperformed compared to national graduation statistics.

A review of the dropout rate in Colorado schools revealed a gradual improvement from 2017 to 2019, when a 1.7% total dropout rate was reported (CDE, n.d.). By race and ethnicity, the dropout rate was 1.2% White, 3% Black or African American, 3.2% Hispanic or Latino, 0.8% Asian, 3.4% Native Hawaiian or Pacific Islander, 4% American Indian or Alaska Native, and 1.6% two or more races (CDE, n.d.). Males dropped out at a rate of 2.3%, and for females, the rate was 1.7% (CDE, n.d.). Disaggregated dropout rates for other student background factors in 2019 included 2.8% for students considered economically disadvantaged, 2.3% for students with disabilities, and 3.7% for those with limited English proficiency (CDE, n.d.). Colorado outperformed the national dropout statistics even though, comparatively, the graduation statistics lagged behind national percentages for every reported race and ethnicity.

Parsing the graduation and dropout data nationally and in Colorado by student background factors can provide context for who succeeded, resulting in favorable high school outcomes. It is vital to understand these factors because how youth fare on school outcomes correlates to societal and individual experiences beyond high school. A review of the impact of

high school graduation on future economic success and additional factors provided the rationale behind this study. Specifically, the goal is to pinpoint the data that will prevent failure in high school and set students on a path to graduate on time.

### **Societal and Individual Impacts of Dropping Out**

A considerable body of research has revealed deleterious outcomes for adults who dropped out of high school. In particular, earning a high school diploma is one of the most important factors associated with social and economic success in the United States (National Research Council, 2011). Graduating from high school has been regularly cited as a standard minimum requirement for post-secondary training and serves as a minimum competency level for higher education and higher-paying jobs (National Research Council, 2011). A review of the related literature revealed that the ramifications of dropping out negatively impacted the individual who did not graduate and placed an additional burden on the greater community.

The historical employment outlook for students who dropped out of high school is dismal. As an example, the NCES (n.d.) reported a national unemployment rate of 4.3% in 2017; however, for individuals aged 25 to 64 who had dropped out of high school, that figure reached 8%. For the categories of race, gender, and age, NCES (n.d.) data has demonstrated that unemployment was highest among those who dropped out of high school versus high school graduates or those who attained higher levels of education between 2015 and 2017. The U.S. Bureau of Labor Statistics (n.d.) confirmed as recently as April 2019 through April 2020 that the unemployment rate was about 2% higher for people without a high school diploma. One Georgetown University report found that, among typical jobs that required less than a high school diploma, only 27% of positions were filled by people who dropped out of high school in comparison to 42% of positions filled by those with at least a high school diploma (Carnevale et

al., 2013). In other words, over 70% of positions suited for workers with less than a high school diploma were filled by individuals who had obtained higher levels of education (Carnevale et al., 2013), demonstrating that employment prospects improved as students acquired more education.

Beyond employment, studies have shown that there are also differences in annual earnings between those with and without high school diplomas. Among people aged 25 to 34, the mean annual earnings for those who had not completed high school in 2014 was \$25,000 as opposed to those who completed high school, who had mean annual earnings of \$30,000 (NCES, n.d.). The societal impact of unemployment includes lower tax contributions through the loss of lifetime income tax, estimated at the individual level at \$60,000 (Belfield & Levin, 2007). Calculations on one cohort of 18-year-old persons who never completed high school estimated that the national loss in tax contributions and income was \$156 billion or 1.3% of the gross domestic product (GDP; Belfield & Levin, 2007). Students who do not obtain a high school diploma experience more adverse impacts than any other subset of the workforce, and statistics have shown that communities also suffer.

As one measure of community impact, participation in anti-social behavior that led to arrests or incarceration has been associated with education. In the report *Fight Crime: Invest in Kids*, a nonprofit anti-crime organization found that students who dropped out of high school were more than three times likelier to be arrested and more than eight times likelier to be incarcerated compared to their peers who graduated from high school (Christeson et al., 2008). This finding was corroborated by Maynard et al. (2015), who found a significantly higher arrest history for students who dropped out than for high school graduates. Lochner and Moretti (2004) studied arrest rates among those who graduated and dropped out and found an estimated 70% reduction in arrest rates for those who finished the 12<sup>th</sup> grade versus those who only finished the

11<sup>th</sup> grade. The difference between dropping out in the 11<sup>th</sup> year of school versus graduating in the 12<sup>th</sup> year was the reduced probability of incarceration by 0.1% for men who identified as White and 0.37% for persons who identified as Black (Lochner & Moretti, 2004). Separating race from the analysis when looking at dropout rates was challenging since males who identified as Black and Hispanic were disproportionately more likely to drop out (Rumberger & Thomas, 2000) and be incarcerated (Lochner & Moretti, 2004) than males who identified as White. Further, the Bureau of Justice Statistics reported that the direct cost of the criminal justice and corrections system to the U.S. government was \$295.6 billion in 2016 (U.S. Department of Justice, n.d.). These data reveal how arrests and incarcerations resulted in additional costs to society for related public services.

In addition to unemployment and criminal engagement, further adverse effects of dropping out have been substantiated through research. One study revealed that students who dropped out were four times more likely to experience negative life outcomes, including being fired from a job, poor health, illicit substance use, or receive government assistance (Lansford et al., 2016). Research conducted in the mid-2000s demonstrated that approximately 28% of people who dropped out of high school lacked health insurance, whereas 16% of those who graduated from high school and 6% of college graduates were without health insurance (Belfield & Levin, 2007). Each additional high school graduate saved the government an estimated \$39,000 annually in health costs (Belfield & Levin, 2007). Maynard et al. (2015) found that those who dropped out of high school reported having attempted suicide more often than those who graduated. Lansford et al. (2016) also observed that negative impacts were more pronounced for people with low socioeconomic status. Oreopoulos and Salvanes (2011) uncovered some non-pecuniary outcomes of dropping out, such as higher rates of divorce, worse mental health, and



higher self-reported rates of using corporal punishment in child-rearing. Finally, people with more education typically lived longer, led healthier lives, and held jobs that enabled greater access to health insurance and health care (Belfield & Levin, 2007). In sum, these studies showed that dropping out of high school correlated to negative implications for individuals and negatively impacted community resources and safety.

### **Risk Factors Correlated to Dropping Out**

As early as the 1990s, many studies have attempted to pinpoint the risk factors that predict who will drop out or graduate from high school. In one study, school-level factors were defined as the rate assessed for particular characteristics that presented challenges to completing high school (Hammond et al., 2007). School rates for achievement, attendance, grade retention, the concentration of racial and ethnic minority students, suspensions, and socioeconomic status all have been correlated to an individual student's likelihood to graduate on time or drop out (Balfanz & Legters, 2004; Christle et al., 2007; Easton et al., 2017; Rumberger & Thomas, 2000). Most school-level factors tend to be less manipulable by school personnel despite their influence on student success.

Scholars have also identified numerous school-level factors that can be classified as individual factors that increased the risk of dropping out (Allensworth & Easton, 2007; Balfanz & Legters, 2004; Christle et al., 2007; Easton et al., 2017; Neild & Balfanz, 2006; Rumberger & Thomas, 2000). Individual factors can be categorized further into background factors and performance factors (Hammond et al., 2007). Individual background factors are generally defined as unalterable demographic characteristics used to describe students, including socioeconomic status (SES), race and ethnicity, gender, disability status, being retained in school, and English language proficiency level (Allensworth & Easton, 2007; Balfanz & Legters,

2004; Christle et al., 2007; Dynarski & Gleason, 2002; Easton et al., 2017; Gwynne et al., 2009, 2012; Hammond et al., 2007; Hillman, 2014). Individual performance factors reflect how students engage with school and include course grades, test scores, grade point average (GPA), attendance, and discipline (Allensworth & Easton, 2007; Balfanz & Legters, 2004; Christle et al., 2007; Dynarski & Gleason, 2002; Easton et al., 2017; Gwynne et al., 2009, 2012; Hammond et al., 2007; Hillman, 2014). In this study, an analysis of individual background and performance factors provided additional insight into who benefited most from a school setting.

While Hammond et al. (2007) provided a way to categorize student and school risk factors, almost every study consulted during the course of this project previous to Hammond's designations examined the risk factors related to high school graduation and dropout rates in some form. Past studies zeroed in on distinctive environmental contexts (urban, suburban, rural), various levels of schooling (elementary, middle, and high), and nuanced definitions of contributing factors, including failing grades or GPA, discipline referrals, or school suspensions (Allensworth & Easton, 2007; Balfanz & Legters, 2004; Christle et al., 2007; Easton et al., 2017; Hillman, 2014; Neild & Balfanz, 2006; Rumberger & Thomas, 2000). These previously studied risk factors provide a starting point for school leaders interested in determining the most accurate and reliable predictors of dropping out, potentially leading to the development of systems for early identification, intervention, and prevention in order to help the identified students graduate on time.

### **Early Warning Systems**

The historical context of the development of an early warning system (EWS) provides an equity lens through which to closely examine how students have performed in high school. As a first step toward equality, the Civil Rights Act of 1964 outlawed discrimination and segregation

and mandated an educational survey of how public schools in the United States served all students (Coleman, 1968). Sociologist James Coleman led that work, which included a survey of 650,000 students in more than 3,000 schools throughout the United States (Coleman, 1968). The resulting 749-page report never referred explicitly to early warning systems; however, it provided information on identifying the impact of specific inputs on a child's education (Coleman, 1968). Over the ensuing 50 plus years since Coleman's study, students have engaged in public school education with varied success.

More specifically, numerous studies since Coleman's report have delved into graduation and dropout data. These studies added further precision and accuracy to forecasting which students need an intervention to overcome those factors (Allensworth & Easton, 2005; Balfanz et al., 2007; Baltimore Education Research Consortium [BERC], 2011; Bowers et al., 2013; Dynarski & Gleason, 2002; Easton et al., 2017; Goldschmidt & Wang, 1999; Hammond et al., 2007; Heppen & Therriault, 2008; Neild & Balfanz, 2006). One concept that emerged and gained formal recognition is known as the EWS, referring to a coordinated school effort that both identifies students who are at the highest risk for dropping out of high school and supports them with resources and interventions to prevent this negative outcome (Bruce et al., 2011; Heppen & Therriault, 2008). Early warning indicators (EWIs) are the individual data points schools have used to monitor student progress toward graduating from high school on time (Allensworth & Easton, 2005). Throughout the literature, EWIs are referred to interchangeably as predictors, factors, flags, and indicators. To date, studies of EWS have spanned elementary through high school, and they were most prominent in urban settings, although some studies in suburban and rural settings occurred.

Recently, Bruce et al. described EWS as “an emerging tool, with most EWS design starting no earlier than 2006” (2011, p. 21). For the most part, the success of EWS interventions mainly has been determined by how students performed related to the specific performance indicator that signaled an intervention was needed (Bruce et al., 2011). In other words, the evaluation of EWS has focused on the improvement of the specific performance factor intended to be impacted, such as grades or attendance, rather than a change in the ultimate overall goal of graduation (Bruce et al., 2011). In a pilot conducted at three Philadelphia schools, the implemented EWS resulted in 56% fewer students falling off track in attendance, 53% fewer off track according to the discipline indicator, and 78% fewer off track in literacy (Bruce et al., 2011). To provide a more comprehensive solution, Diplomas Now was created as one of the first models of whole-school improvement that also incorporated an EWS (Bruce et al., 2011). Designed for the most challenged schools in U.S. metropolitan areas, Diplomas Now was linked to reducing the number of students with office disciplinary interventions and attendance issues by half, and the number of students failing courses was reduced by three-fourths (Bruce et al., 2011). In sum, EWSs have shown promise as a way to systematically identify and support students, and validating EWIs in local contexts was imperative to creating a strong EWS.

The task of validating local thresholds can be achieved by starting with the research base on EWI. For example, Bowers et al. (2013) analyzed 36 studies to compare the sensitivity and specificity of 110 dropout flags to reduce the errors in identifying at-risk students. Their analysis found that “some of the most accurate dropout indicators are tracked longitudinally and focus on attendance and low or failing grades” (Bowers et al., 2013, p. 13). Of the 110 flags reviewed, the highest true-positive (highly sensitive) and low false-positive proportion was math achievement (Bowers et al., 2013). The fact that Bowers et al. (2013) identified longitudinal data and student

improvement over time as superior to cross-sectional data suggested further consideration of a systematic approach to data monitoring. In an earlier study, Heppen and Therriault (2008) also stressed the benefit of EWS to identify support for students.

Multiple studies have demonstrated that ninth grade is a particularly crucial year that significantly predicts high school outcomes (Allensworth & Easton, 2007; Easton et al., 2017; Heppen & Therriault, 2008). As a related point, elementary and middle school-level indicators are significantly predictive of ninth-grade success (Kieffer & Marinell, 2012) and, to a lesser degree, predict graduation and dropout outcomes at twelfth grade (Silver et al., 2008). Bruce et al. (2011) reinforced the benefit of EWS to school leaders in this way:

The research base is clear that the early years of adolescence are a critical time when students are launched on a path toward high school graduation and college readiness or begin to disengage from school and start the downward spiral that often ends in dropping out. (p. 49)

This slow-forming pattern of disengagement may not be recognized as such, and intervention has been revealed as essential to put students on track to successfully engage in school (Bruce et al., 2011). For example, some students with a low probability of graduating as determined by EWS in middle school were able to get back on track for graduation with proper intervention and support (Bruce et al., 2011). Previous research on EWIs has also indicated the value of examining EWS as early as elementary school.

The studies reviewed here illustrate that an EWS and the monitoring of the EWIs that informed early warning systems demonstrated promise for setting students on a path to graduation. However, additional research validating the relevance of EWIs needs to be completed at various grade levels and in more community contexts, such as suburban and rural

communities. Past research revealed that identifying the most reliable EWI and implementing relevant interventions increased the likelihood that students would graduate from high school. Further examination of how students with different background factors perform on a given EWI in various contexts was needed to support subsets of students who disproportionately fail to graduate. Institutional knowledge about how students fare in a school system can be used to inform a responsive intervention system and generate progress toward greater equity among schools throughout the U.S.

### **Purpose of the Current Study**

Past research can be used to provide directions for school administrators interested in raising graduation rates and ensuring that more Colorado and local youth graduate on time. Substantial evidence points to the importance of implementing an early warning indicator monitoring system to identify students on a path toward disengagement early in their school experience (Bruce et al., 2011; Silver et al., 2008). In related contexts, the identification of accurate EWIs was cited as part of a comprehensive EWS designed to increase the likelihood of graduation via the delivery of necessary interventions (Bruce et al., 2011; Silver et al., 2008). The full adoption of an early warning system requires a commitment by educators to divert students from poverty to economic success by supporting, intervening, and thus advocating for their graduation from high school. Past studies revealed that this systemic approach was not pursued in locations where dropping out of high school was an accepted practice (Bruce et al., 2011). Further, the identification of EWIs was foundational to supporting students to graduate from high school on time. As a result, the purpose of this study was to determine through

statistical modeling the individual performance factors that accurately predicted which middle school students graduated on time or dropped out of high school and which middle school students were on track to graduate at the end of the ninth grade.

### **Significance of the Current Study**

Historically, graduating from high school has been described as the most familiar coming of age ritual practiced in the United States (Chappell et al., 2011). It symbolizes a younger generation crossing over into the more advanced and powerful sphere of adulthood (Chappell et al., 2011). This milestone has been associated explicitly with improved future employment, educational opportunities, health, access to healthcare, and additional beneficial outcomes (Belfield & Levin, 2007; Carnevale et al., 2013, Lansford et al., 2016). However, Colorado youth have persistently graduated at lower levels than the national average, and the data for students disaggregated by background factors has revealed even more dismal outcomes (CDE, n.d.; NCES, n.d.). This study was conducted to assist school leaders committed to the accurate identification of at-risk students early in their educational careers. The data will allow such leaders to provide interventions that lead to graduation, allowing them to devote time and resources to this effort.

### **Research Questions**

This quantitative study focused on analyzing individual performance factors in middle school for their correlation to graduating on time or dropping out. The connection between individual performance factors in middle school and the proximal outcome of being on track at the end of the ninth grade was also explored. Student background factors were examined to determine how they moderated the relationships between the individual performance factors and the outcomes. The following questions informed the study:

- Q1 How do the individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades predict that a student will drop out of high school?
- Q1A Do these associations vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status)?
- Q2 How do the individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades predict that a student will graduate on time from high school?
- Q2A Do these associations vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status)?
- Q3 How do the individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades predict that a student will be on track to graduate at the end of the ninth grade (six credits earned and no failing grades in math or English)?
- Q3A Do these associations vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status)?

### **Chapter Summary**

Most of the school-age students living in the United States attend a public school. This study aims to increase the number of students who successfully graduate from high school on time by supporting school administrators seeking to identify when students are at-risk of not meeting this goal. Once students are identified, then school administrators can ensure intervention and support is provided to students in a timely manner. Results from this study has implications for practice and policy related to the successful identification of students who are not succeeding in the public education system.



## **CHAPTER II**

### **LITERATURE REVIEW**

This literature review included pertinent studies on student outcomes of dropping out and graduating on time from high school in the United States. Over time, researchers have identified an array of factors that influence both of these high school outcomes. The present review consulted studies that explored the most significant categories of school-level factors, individual performance factors, individual background factors, and EWIs. Individual background factors encompass grade retention, race and ethnicity, socioeconomic status, disability status, English language proficiency status, and gender. School-level factors are characteristics that describe the school as a whole. Individual performance factors reflect student performance in school specific to academic performance, attendance, and disciplinary incidents. The EWI section summarized past findings by school level, the purpose of using EWIs to identify students, and information justifying the identification of EWIs as superior to other practices of identifying students who fall off track to graduate from high school. The reviewed studies on EWI included the dependent variables of dropout status, graduation status, and on track for graduation at the end of the ninth grade. A more detailed review of the relevant studies follows below.

#### **Factors Associated with Dropping Out and Graduating**

The literature on high school dropout and prevention is extensive. Past studies identified several factors associated with dropping out of high school and conditions that signaled a student

was likely to graduate. These factors were organized into school factors, individual performance factors, and individual background factors.

### **School Factors**

First, school-level factors have presented challenges for students from those communities and schools (Hammond et al., 2007). As an initial example, among ninth-grade students in Los Angeles Public Schools, 25% of the variation in student performance in middle and high school was explained by a school's rate of mobility, success in Algebra, and course failures (Silver et al., 2008). In fact, Silver et al. (2008) found that school factors played a more prominent role in a student's likelihood to graduate than individual background factors in the L.A. Unified School District. Rumberger and Thomas (2000) have argued that schools with higher percentages of students considered as coming from low-SES backgrounds had 60% higher dropout rates, and average SES schools had 40% higher dropout rates than high-SES schools. Other school factors associated a higher probability of dropping out with a concentration of students who were retained at least one year, higher school percentages of students considered at-risk, and higher overall school truancy rates, which held regardless of individual background factors (Hammond et al., 2007; Rumberger & Thomas, 2000).

In their study, Rumberger and Thomas (2000) also did not find any significance for dropout rates until the school minority rate was over 40%. The authors also uncovered higher student turnover rates associated with this factor. Balfanz and Legters (2004) concluded that schools with a majority of students from minority racial and ethnic backgrounds were five times less likely to promote students on time, setting them on a course for dropping out. However,

school-level conditions in isolation did not account for all of the variations among students. Previous studies also indicated that individual student factors were significantly correlated to high school outcomes.

### **Individual Performance Factors**

Three areas of student performance in school emerged in the literature as highly correlated to high school outcomes: student academic performance in school, school attendance, and the frequency of disciplinary incidents students experienced. Each area of student performance in school described below was defined in past studies. They can be referred to collectively as individual performance factors.

#### *Academic Performance*

The academic performance of students was highly correlated to high school end status. Standardized assessments of learning, course grades, and grade point average (GPA) were the main areas of academic performance that past studies linked to dropping out and graduating from high school. Grade point average is calculated by dividing the number of credits earned by the total number of credits possible. The relevant literature included studies of test scores, course performance in high school, and course performance prior to high school.

**Test Scores.** Test scores had mixed results as predictors of high school graduation and dropping out. Allensworth and Easton (2007) found that among students with high eighth-grade test scores, almost one-quarter were off track to graduate by the end of ninth grade, while Kieffer and Marinell (2012) argued that test scores in fourth and eighth grades were predictive of graduating from high school. Allensworth and Easton (2005) called into question using test scores, stating that “many students enter high school with relatively weak test scores, yet are on-track in their freshman year and graduate in four years” (p. 7). In a later study, Allensworth et al.

(2014) reviewed the performance of middle school students and found that students with higher test scores tended to earn higher grades in high school, while students with lower test scores earned lower grades. However, the authors also maintained that course grades, not test scores, were the stronger predictor of high school outcomes. Easton et al. (2017) also analyzed middle school test scores, resulting in mixed success in predicting student success in ninth grade. Overall, test scores indicated the academic preparedness for students to succeed in school, but they were not the most robust indicators.

**Course Performance in High School.** Course grades and GPA provided a measure of the academic performance factor and proved superior to test scores in predicting high school outcomes. In Chicago Public Schools, Easton et al. (2017) found that ninth-grade GPA accurately predicted high school standardized test scores, and test scores prior to the ninth grade were not strong predictors of success in the ninth grade. More than one “F” grade in the ninth grade significantly reduced the likelihood of graduating on time, and most students earned nearly the same GPA in the eleventh grade that they earned in the ninth grade (Easton et al., 2017). Chicago ninth-grade students with a GPA of “A,” “B,” or “C” graduated on time, while 18% of those with an “F” average and 60% of those with a “D” average graduated on time (Easton et al., 2017). A passing final course grade resulted in earned credit in high school, which was the basis for meeting graduation requirements. Being on track with the number of credits earned (one or fewer course failures) at the end of the ninth grade was predictive of graduating on time, and predictions were not improved by information from student background factors (Allensworth & Easton, 2007; Allensworth et al., 2014; Neild & Balfanz, 2006). Course failures and GPA both signaled when students were off track to graduate as early as the end of the ninth grade.

**Course Performance Before High School.** Other studies illuminated the urgent nature of developing solid academic knowledge and skills prior to high school. In studies of schools in Baltimore, California, and Philadelphia, course failures in the middle grades significantly predicted the likelihood that students would drop out of high school (BERC, 2011; Kurlaender et al., 2008; Neild & Balfanz, 2006). In one study focused on Philadelphia schools, Balfanz (2009) found that sixth-grade students who failed one English language arts or math course had only a 10% to 20% chance of graduating from high school on time. He further illustrated that as early as the sixth grade, students who demonstrated they lacked the knowledge and skills to pass math or English courses successfully were unlikely to remedy that lack of skill without intervention (Balfanz, 2009). Similar results among sixth-grade students in Baltimore City Schools showed that failing one English or math course or a failing average in all four core subjects was strongly associated with not graduating on time (BERC, 2011). Hillman (2014) also provided data that one failing grade in math in the sixth grade significantly increased the likelihood that a student would not graduate from high school. Balfanz (2009) concluded that the earlier students developed off track indicators, the more likely they were not to graduate on time. Balfanz (2009) added, however, that there appeared time for remediation based on the finding these students demonstrated resilience by staying in school for an additional five years beyond their first signs of falling off track.

Student achievement at elementary school levels was also predictive of later success in high school (Cratty, 2012). Inconsistent growth in math and English language arts achievement proved a statistically significant predictor of dropping out of high school for every grade level beginning in the third grade (Cratty, 2012). Small increases in math and reading achievement reduced the risk of dropping out for all except those students with the lowest initial ability

(Cratty, 2012). In a national longitudinal study of over 4,000 children, Hernandez (2011) confirmed the importance of developing academic competence in the early grades, stating that “one in six children who are not reading proficiently in third grade do not graduate from high school on time, a rate four times greater than that for proficient readers” (p. 3), a staggering statistic.

Past studies also clarified that grades, not test scores, are a stronger predictor of later success. Grades reflect more than student knowledge of content and encompass non-cognitive skills needed for success (Brookhart et al., 2016). Brookhart et al. depicted the nature of grades and their credibility by noting that “grades assess a multidimensional construct containing both cognitive and non-cognitive factors reflecting what teachers value in student work” (2016, p. 2). The overall conclusion of these related studies indicates that course performance in elementary and middle school, when monitored through course grades or GPA, predicted success in high school.

### ***Attendance***

Poor attendance in elementary, middle, or high school proved one of the most reliable indicators of dropping out of high school (Hammond et al., 2007). Absenteeism was a significant predictor of dropping out in several comprehensive studies (Allensworth et al., 2014; BERC, 2011; Kieffer & Marinell, 2012; Kurlaender et al., 2008; Neild & Balfanz, 2006). For example, in a study of Chicago Public Schools, as course attendance improved, students earned higher grades and had lower rates of failing grades (Allensworth & Easton, 2007). In fact, course attendance in eighth grade was eight times more predictive of course failure in ninth grade than eighth-grade test scores (Allensworth & Easton, 2007). Once achievement and attendance were

accounted for, student background factors did not further assist predictions of who would graduate (Allensworth & Easton, 2007; Neild & Balfanz, 2006).

In another middle school study, Balfanz (2009) found that attendance of less than 80% indicated students were on a trajectory to drop out, and in some cases, the threshold was closer to 90%. Bowers et al. (2013) affirmed the importance of attendance, stating that attendance trajectories and achievement were the most effective indicators for developing an effective EWS. Cratty (2012) considered school suspensions alongside attendance data and stated that regardless of the reason for missing school, excessive absences correlated to dropping out of school. Poor attendance as early as fourth grade and declining attendance in the middle grades both indicated that students were off track to graduate (Kieffer & Marinell, 2012). Hillman (2014) found that missing ten days, or 6% of the school year, in the sixth grade reduced the probability of graduating from high school on time.

Based on the wealth of findings that have connected low attendance to poor school outcomes, the National High School Center recommended that early warning systems include missing 10% or more of instructional time as an indicator for being off track for graduation (Therriault, O’Cummings, Heppen, Yerhot, & Scala, 2013; Therriault, O’Cummings, Heppen, Yerhot, Scala, & Perry, 2013). The reasons for absences (e.g., illness, suspension) were irrelevant, rather, the amount of instructional time students missed was most important (Therriault, O’Cummings, Heppen, Yerhot, & Scala, 2013; Therriault, O’Cummings, Heppen, Yerhot, Scala, & Perry, 2013). Studies consistently demonstrated that the chances of students successfully graduating from high school were reduced when students were absent from instruction for more than 10% of a school year at any academic level.

### *Student Discipline*

Throughout the literature, the number of disciplinary actions students experienced was cited as a predictor of high school outcomes. In recent years, researchers have increasingly studied the disproportionality in school discipline in K-12 education (Welsh & Little, 2018). Disparities existed among low-income and students identified as racial or ethnic minorities, who have experienced exclusionary discipline actions more often than their peers (Welsh & Little, 2018). These inequalities have been explained in part by school and classroom policies, practices, and the perspectives of teachers and school administrators (Welsh & Little, 2018). This conclusion suggests that the likelihood of student discipline is related to school culture, staff belief systems and perspectives, and the reaction among students to those factors.

While student behavior was cited in the literature as an individual performance factor that could be used reliably to determine who was off track for graduation, the evidence suggested that remedies to disparities in discipline “should focus on the disposition and biases of teachers and school leaders’ behavior management rather than the student misbehavior” (Welsh & Little, 2018, p. 773). For this study, the term *discipline* refers specifically to a disciplinary action taken by a school official toward a student that involved a referral to the school office. While past studies on EWS used the term *behavior*, which focused on the student, this study will focus on discipline events in recognition of the complex interplay between the dispositions and beliefs of school leaders, staff, and students. The interrelatedness of student engagement and discipline was emphasized by Balfanz et al. (2007), who stated:

One clear finding from prior work on dropout predictors is that, although different students begin their disengagement from school for different reasons, two clear paths emerge: one rooted primarily in academic struggle and failure and another grounded



more in behavioral reactions to the school environment (misbehavior in school or a demonstrated aversion to attending school). (p. 225)

With that context, a review of the literature on discipline revealed that researchers quantified this measure in various ways.

Student suspension from school and removal from classrooms were the most prominent definitions of discipline in past studies. For example, suspension from school emerged as a significant indicator of dropping out for all students, regardless of gender, disability, or socioeconomic status (Allensworth et al., 2014; BERC, 2011; Kieffer & Marinell, 2012; Kurlaender et al., 2008; Neild & Balfanz, 2006). Christle et al. (2007) corroborated that suspension rates connected clearly to an individual student's likelihood of dropping out of high school. In a longitudinal study by Goldschmidt and Wang (1999), when the authors controlled for all other individual characteristics, removing students from class as a disciplinary tool in eighth grade was the most significant predictor of students who would drop out in grades ten through 12. For students who dropped out in middle school or grades eight through ten, removal from class as a disciplinary tool was the second strongest indicator after being held back one grade (Goldschmidt & Wang, 1999). Balfanz et al. (2012) later examined over 180,000 first-time ninth-grade students and found a decreased likelihood of on-time graduation for every single suspension they incurred. Hillman (2014) revealed that students in the sixth grade who experienced five or more office referrals as a disciplinary action represented 72% of the dropouts for that same cohort. Cratty (2012) concluded that even one additional week of an absence or suspension significantly increased a student's chances of dropping out. The National Dropout Prevention Center also identified suspension or expulsion as among the 25 top risk factors associated with the increased risk of dropping out (Hammond et al., 2007).

Taken as a whole, individual performance factors had a strong connection to high school outcomes. Test scores had mixed results for predicting who dropped out of high school. However, course performance, attendance, and the number of disciplinary actions students experienced correlated to the level of success students experienced in high school. The studies consulted provided decisive evidence from elementary, middle, and high schools that individual performance factors must be considered to correctly identify students off track for graduation.

### **Individual Background Factors**

Individual background factors are descriptive and represent characteristics outside the control of students. A review of the literature revealed recurring individual background factors associated with high school outcomes. The background factors of grade retention, race and ethnicity, socioeconomic status, disability status, English language learner status, and gender were included in this literature summary.

#### ***Grade Retention***

Educators and parents have utilized grade retention as a viable strategy for students who are behind academically or lack maturity. However, some academic studies have contradicted the merit of this practice. For example, a longitudinal study following students from third grade through high school revealed that retention, even as early as in third grade, significantly increased the probability of dropping out (Lloyd, 1978). In later research, Jimerson et al. (2002) also concluded that early grade retention correlated highly to dropping out, and the chances of dropping out increased significantly if the retention occurred in grades six through eight. The authors stated that “early grade retention is one of the most powerful predictors of early school withdrawal” and urged educators against using this as a strategy for academic intervention (Jimerson et al., 2002, p. 452). Kurlaender et al. (2008) found that among middle school

students, grade retention was one of the three most significant indicators that predicted who dropped out of high school. An additional study concluded that “being held back at least one grade doubles the probability that a student drops out of middle school” (Goldschmidt & Wang, 1999, p. 726). Cratty (2012) conducted a longitudinal study of over 60,000 students beginning in the third grade and found that retention at any grade level was significantly correlated to dropping out. Finally, a study of Baltimore City Schools revealed that over three-quarters of students who were retained did not graduate by the end of the 2007–08 school year, making retention the strongest predictor of non-graduation (BERC, 2011). In sum, past research clearly connected grade retention to dropping out of high school and was not supported as a strategy for students who struggle academically.

### ***Race and Ethnicity***

As a student-level factor, race and ethnicity have been less predictive of graduating or dropping out than other factors. Studies have illuminated statistically significant differences in national dropout rates for students identified as American Indian or Alaska Native, Black, Hispanic, or Pacific Islander as compared to students identified as White or Asian, and students identified with these race and ethnicity groups were also disproportionately impacted by poverty (McFarland et al., 2018). In relation to Chicago Public Schools, Allensworth et al. (2014) explained that race and ethnicity did not add value to predicting high school outcomes beyond the information garnered on individual performance factors such as grade point average (GPA), attendance, and test scores. Ethnicity was linked to the probability of high school graduation when combined with other background and school factors in a suburban study in Colorado (Hillman, 2014). However, most studies have clarified that race and ethnicity were less predictive of high school outcomes than other factors, including course grades and attendance.

### ***Socioeconomic Status***

The percentage of students eligible for a free or reduced-price lunch (FRL) under the National School Lunch Program often has served as a proxy to identify low socioeconomic status (NCES, n.d.). Relatedly, Christle et al. (2007) found that the poverty rate is related to a student's likelihood of dropping out of high school. In one Chicago Public Schools study, a key finding correlated ninth-grade GPA to the socioeconomic level of the neighborhood in which the student resided (Easton et al., 2017). A lower SES of the neighborhood was associated with a lower GPA among the students from that neighborhood (Easton et al., 2017). Cratty (2012) emphasized FRL as a significant indicator that signaled the need for intervention as early as elementary school, stating:

as of third grade, FRL students are predicted to dropout at twice the rate of non-FRL students (i.e., 1.98, or 98% higher) just by virtue of being FRL, and that their lower initial test scores, etc., are associated with an additional 68% higher probability of dropping out. (p. 654)

Another longitudinal study of nearly 4,000 students found that 38% of the population studied spent at least one year in poverty, yet those students accounted for 70% of the dropouts (Hernandez, 2011). The authors clarified that “even among poor children who were proficient readers in third grade, 11% still didn't finish high school. That compares to 9% of subpar third grade readers who have never been poor” (Hernandez, 2011, p. 4). Thus, the impact of socioeconomic status on individual performance factors was significant and clear.

### ***Disability Status***

The Individuals with Disabilities Education Act (IDEA) of 2006 provided guidance to allow for different graduation requirements for students with disabilities (Schifter, 2011). Under

IDEA, students were identified as having a disability through a school review process and subsequently provided with an individualized education plan (IEP) (NCES, n.d.; U.S. Department of Education, n.d.). In order to qualify for an IEP, an educational impact assessment was documented for each student (CDE, n.d.). IEP teams determined which courses were required for high school students to graduate, and by the age of 16, IEP teams made transition decisions for graduation (Schifter, 2011). Furthermore, IDEA allowed some students with IEPs to receive special education services in high school through the age of 21 (Schifter, 2011).

Despite continued allowances for varying graduation requirements under IDEA, the National Dropout Prevention Center identified disability as one of the 25 top risk factors associated with dropping out (Hammond et al., 2007). Ingram (2006) found that students identified as having learning disabilities were more likely to drop out of high school, and when the background factor of low-SES was added, they had a greater chance of dropping out compared with their high-SES peers. In some cases, students with learning disabilities graduated at higher rates than their peers with similar cognitive abilities (McGee, 2011). McGee (2011) further clarified that there could be many explanations for this result, including the possibility that the additional interventions worked or their individual graduation plan allowed for the completion of less rigorous coursework. A student with a learning or emotional disability is often impacted at the educational level, and disability status likely overlapped with achievement or discipline-related factors.

### ***English Language Proficiency Status***

The Colorado Department of Education (n.d.) required schools to identify students as English language learners (ELLs) by proficiency levels and then deliver an evidence-based English language development (ELD) program to them. ELL students are required to participate

in annual state assessments of language proficiency until they reach a proficiency level in English high enough to exit the ELD program (CDE, n.d.). One issue with this system of releasing students from ELD was that in most studies, only students identified for ELD at the time of the studies were included in the analysis of dropout and graduation rates (Kieffer & Parker, 2017). Students who successfully progressed in their language development and exited ELD were not typically included in later analyses of high school outcomes (Kieffer & Parker, 2017). As a result, a careful examination should be given to how past and current students identified as ELL are included in studies.

The process of reclassifying students considered ELL as they developed stronger English language skills resulted in very few studies with longitudinal outcomes for those identified as ELLs, and fewer researchers included those who exited ELD programs prior to graduation (Hopkins et al., 2013; Kieffer & Parker, 2017). In a longitudinal study in New York City, Kieffer and Parker (2017) found that about 64% of students identified as ELL when they entered fifth or sixth grade graduated on time. The state accountability report card for that same graduating class reflected a 52% graduation rate for those who qualified as ELL in the 12<sup>th</sup> grade as compared to a 77% overall graduation rate for that class of students (Kieffer & Parker, 2017). It was not clear how many of the students identified as ELL when they entered fifth or sixth grade in the Kieffer and Parker (2017) study were still ELL in the 12<sup>th</sup> grade. The same study revealed that students considered ELL progressed at different rates with English development, and those who received long-term services graduated at lower rates than those who exited ELD programs in a shorter amount of time (Kieffer & Parker, 2017). However, few studies have considered the difference in graduation rates between students who left ELD programs and those who continued to receive ELD services.

Corroborating the findings of Kieffer and Parker (2017), one study of Chicago Public Schools revealed that the four-year graduation rates for students identified as ELL varied depending on the language level of students (Gwynne et al., 2012). Gwynne et al. (2012) studied students identified as ELL in four categories: long-term proficient (proficient in English before sixth grade), recently proficient (former ELLs who achieved English proficiency in sixth grade or later), long-term ELLs (first determined to be ELL before sixth grade and not yet proficient in English), and new ELLs (first determined to be ELL in sixth grade or later and not yet proficient in English). In this study, the graduation rates for those categories of students were 61% for proficient ELL, 57% among recently proficient ELL, 56% for long-term ELL, and 57% for new ELL (Gwynne et al., 2012). Students identified as ELL had a wide range of performance outcomes, and these data suggest it may be related to their English proficiency.

In addition to graduation rates, NCLB defined school success for students identified as ELLs through a school's rate of reclassifying students yearly (Hopkins et al., 2013). Further, ESSA allowed states to determine how ELL progress was reported in school performance frameworks (Hess & Eden, 2017). Colorado continued to use the model of reporting both graduation rates and reclassification rates for school performance frameworks (CDE, n.d.). This risk factor overlapped with the low achievement risk factor since, by definition, a student identified as an ELL had an educational impact related to English language development. One recommendation from past studies was that any analysis of success in terms of high school outcomes among students identified as ELLs should include an examination of the performance of those currently and formerly identified (Gwynne et al., 2012).

## ***Gender***

An analysis of national graduation and dropout rates in the United States yielded no significant differences between female and male students (McFarland et al., 2018). Females graduated at higher rates and dropped out at lower rates than males, but the 40-year trend differences were not measurably different (McFarland et al., 2018). When gender was examined in particular contexts and for different background factors, there were differences, however. For example, in a study in Chicago Public Schools, females generally earned higher GPAs than boys, with 23.6% of females earning grades of “D” or “F” versus 36.7% of boys earning grades of “D” or “F” (Easton et al., 2017). Gwynne et al. (2009) found that the background factor of gender was significant for high school graduation in Chicago Public Schools, but by comparison, attendance was much more significant in predicting academic failure.

In a study of five urban and suburban school districts in Colorado, the authors noted that males disproportionately dropped out at higher rates than females in four of the five districts (Bennett & Mac Iver, 2009). Interestingly, females tended to have lower suspension and ninth-grade course failure rates than males, two key factors that predicted dropout status (Bennett & Mac Iver, 2009). Early warning indicators in ninth grade were the same for males and females, although the types of life events that led to dropping out were somewhat different between the genders (Bennett & Mac Iver, 2009). This brief review shows that the examination of graduation and dropout rates by gender uncovered some significant differences depending on the school or district context.

## **Early Warning Indicators**

Multiple studies provided information about the early warning indicators that signaled students were on a path to dropping out of high school. These studies described substantiated



thresholds for staying on track to graduate on time, summarizing EWIs by school level and illuminating when the warning signs reliably demonstrated that students required intervention.

High school indicators were solidly established for urban environments and somewhat clarified for suburban locales. Attendance of less than 80% to 90% (depending on the study), credit acquisition, failing grades in math or English language arts, GPA, and discipline were each established as reliable EWIs that indicated being off track for graduation when a student was in the ninth grade (Allensworth & Easton, 2005, 2007; Balfanz et al., 2012; Easton et al., 2017; Hernandez, 2011; Neild & Balfanz, 2006; Silver et al., 2008). The middle school EWI of one or more course failures in math or English language arts, attendance of less than 80% to 90%, and the number of days suspended from school were significantly correlated to reduced odds of graduating from high school in several studies (Goldschmidt & Wang, 1999; Kieffer & Marinell, 2012; Kurlaender et al., 2008; Neild & Balfanz, 2006).

Less research has been conducted that connects elementary individual performance factors to graduation and dropout statistics. In one study, the elementary-level EWIs academic achievement (grades, test scores) and attendance correlated to success in middle school and the ninth grade for those same indicators (Allensworth & Easton, 2007; Kieffer & Marinell, 2012; Silver et al., 2008). Ninth-grade performance was inextricably linked to the likelihood of graduating from high school (Allensworth & Easton, 2007; Balfanz et al., 2012; Easton et al., 2017).

Nearly all studies included in this review were conducted in either metropolitan contexts or involved analyzing statewide data, which the urban centers within those states would have influenced. While individual student background factors were pervasively proven to be less predictive of school success than individual performance factors, two comprehensive studies of

students identified as ELLs pointed to the need to examine this group of students according to their language proficiency levels and progress in the reclassification process (Dynarski & Gleason, 2002; Gwynne et al., 2012). These findings provided a solid starting point for determining the indicators for a comprehensive EWS.

The stated purpose of identifying students who fall off the graduation track is often the delivery of timely support to set students on a path to graduate (Bruce et al., 2011). However, intervention and support require resources, and there are costs associated with resources provided to students who do not need them or those who need additional support but do not receive it (Bruce et al., 2011). As Bowers et al. (2013) maintained:

The costs of poor and inaccurate dropout flags were not only in misspent funds on dropout interventions for students who would have graduated anyway, but also in categorizing students as at-risk when they are not, as well as in missing students who actually are at risk of dropping out. (p. 14)

Multiple studies have identified accuracy in identifying students for intervention as key to resource management (Bowers et al., 2013; Bruce et al., 2011). Early warning indicators inform resource allocation, including budget allocations for interventions.

In the absence of EWIs, teacher judgment was the primary method of identifying students off track for graduating on time or in danger of dropping out (Soland, 2013). Soland (2013) compared EWI variables to teachers' predictions of students who would graduate, drop out, or continue on to post-secondary education. In Soland's study, data from the National Education Longitudinal Study was used to compare teacher predictions to EWI variables derived from the same data set (Soland, 2013). Specifically, teachers were asked to predict which students would complete high school and enroll in college (Soland, 2013). Subsequently, Soland (2013) found

that teachers predicted which students would complete high school with varying accuracy. The EWI variables enhanced teacher predictions, but conversely, teacher predictions did not enhance EWI predictions (Soland, 2013).

This study of teacher predictions focused on students in the tenth grade, and many EWIs were found accurate for students as early as elementary and middle school (Balfanz, 2009; BERC, 2011; Cratty, 2012). Soland (2013) also revealed that with students identified as Latinx or African American, teachers had increased errors in their predictions, demonstrating implicit or explicit bias among teachers. The EWI accurately predicted graduation in cases where teachers disagreed over their predictions of student outcomes (Soland, 2013). Furthermore, Soland (2013) found that experienced teachers made more accurate predictions than less experienced teachers. The Soland (2013) study has suggested that EWIs provide a superior, objective, and more accurate method of identifying students off track to graduate when compared to teacher predictions.

Methodologically, several studies have pointed to the value of examining indicators longitudinally. One meta-analysis by Bowers et al. (2013) showed that a focus on the longitudinal analysis of achievement and attendance trajectories over time was the most effective method for developing an EWS. The authors further contended that “it appears that for policy and research on dropout flags, growth mixture models that include achievement or engagement trajectories are superior to all of the other flags reviewed” (p. 12). Several other studies concurred with the use of longitudinal data (Balfanz et al., 2012; Cratty, 2012; Jimerson et al., 2002). Bruce et al. (2011) reviewed EWS programs from across the United States and found that “powerful indicators can be identified based on the analysis of longitudinal data that tracks individual data over time” (p. 43). For example, Kieffer and Marinell (2012) discovered that

declining attendance through middle school was more predictive of not graduating from high school than isolated low attendance rates that did not have a declining trajectory. Cratty (2012) determined that a decline in math scores over time added substantially to the risk of dropping out regardless of the initial skill level, meaning a decline in performance was more significant than consistent low performance.

### **Chapter Summary**

On the whole, ensuring that students graduate from high school and avert dropping out has far-reaching benefits. First, graduates experience better life outcomes through higher lifetime income, lower unemployment, greater access to health care, and less criminal involvement. More broadly, communities benefit when students graduate—resulting in increased tax revenue, lower crime, decreased unemployment, lower governmental assistance, and lower health care costs. However, research to date into early warning indicators has focused most extensively on metropolitan environments at the high school and middle school levels, leaving a gap in the research on suburban and rural environments. Students, educational leaders, and communities would benefit from research in contexts similar to their own.

Consistently, researchers have confirmed that attendance, discipline, and course performance are the strongest predictors of whether or not a student will graduate from high school (Bowers et al., 2013; Bruce et al., 2011; Hillman, 2014). Being on track to graduate at the end of the ninth grade is often a manifestation of earlier educational experiences and can be highly predictive of graduating from high school (Allensworth et al., 2014; Allensworth & Easton, 2005, 2007; Easton et al., 2017; Hernandez, 2011). Prior to beginning the transition from eighth to ninth grade, students have established habits and built their base of knowledge and skills, making elementary and middle grades critical (Bruce et al., 2011). As a result,

Allensworth et al. (2014) questioned if failure in high school, particularly in the ninth grade, was simply a function of inadequate preparation in middle school. Relatedly, EWIs reliably identified students struggling to stay on track for graduation as early as middle school.

While a multitude of studies have described the predictors that signaled a student was on a path to dropping out (Bowers et al., 2013; Bruce et al., 2011; Hammond et al., 2007), fewer focused on on-time graduation rates. Furthermore, limited studies have considered suburban settings or used longitudinal data that maps EWIs uncovered in middle school to the proximal outcome of ninth-grade performance and the distal outcome of graduating from high school on time. However, such an analysis was deemed essential for school districts that intend to create an EWS that efficiently and successfully improves high school graduation rates for all students.

This study filled a gap in the literature related to a suburban setting and the outcome of on-time graduation. An extensive review of the literature, particularly the study by Hillman (2014), informed its design—the Hillman study was conducted in a suburban Colorado context and linked school performance thresholds in the sixth grade to graduating from high school on time or dropping out. The school performance predictor variables in Hillman’s analysis were the number of failing grades in English language arts, the number of failing grades in math, attendance defined as missing more than ten days of school, and discipline—defined as the number of office referrals in a school year (Hillman, 2014). The student background factors of gender, race and ethnicity, and disability status were also included in Hillman’s study (2014). This study expanded upon Hillman’s work to include the predictor variables of ELL status, FRL status, and GPA. It also broadened Hillman’s study design with the additional analysis of predictive variables in the seventh and eighth grades and a third dependent variable of being on

track at the end of the ninth grade. Overall, this study examined how individual performance factors in middle school predicted high school outcomes in a suburban Colorado setting.

## **CHAPTER III**

### **RESEARCH METHODOLOGY**

This study was based on a quantitative analysis that used binomial logistic regression to analyze the relationship between the indicators of middle school course performance, attendance, and discipline and the outcomes of graduating from high school on time, dropping out, and being on track for graduation at the end of the ninth grade. An overview of the study, including its research questions, method, limitations, and conclusion, has been outlined below.

As noted earlier, this study intended to identify an accurate model of the individual performance factors that best predicted high school outcomes and being on track for graduation at the end of the ninth grade among students in suburban Colorado. In addition to identifying these performance factors, the researcher sought to uncover at which middle school grade the predictors became evident and therefore help identify students for intervention in a timely manner. An extensive review of the literature revealed a strong correlation between ninth-grade performance and high school outcomes, and these studies informed the definition of being on track in the ninth grade: six credits earned in the year and no failing grades in math or English language arts courses. Student background factors were analyzed for their moderating effect on the individual performance factors.

The results of this study included a recommended model of student performance thresholds that reliably signaled a student was at risk of not graduating on time or on a path toward dropping out altogether. The results also informed the conclusion of when during middle school to establish a system to monitor such thresholds. This research can be used in similar

suburban settings to set up an early warning system (EWS) where school leaders monitor student performance according to the indicators included in the final model. Information about which background factors moderate student performance can inform how school leaders tailor their EWS programs to ensure that students receive timely interventions and support.

This study comprised a secondary data analysis of data collected by a school district for their own purposes. The validation of individual background and performance indicators in each grade, six through eight, was completed to form the basis of an EWS in a suburban setting with similar demographics to the participating school district. This validation of EWIs in a unique setting directly addressed a gap in the literature regarding suburban settings. The analysis of factors that predicted on-time graduation also filled a gap since most past studies focused on dropping out of high school. This study can thus provide the basis for school leaders to develop a strategic EWS in similar settings.

### **Research Questions**

This quantitative case study focused on using individual performance factors in middle school to predict which students would graduate on time or drop out. The correlation between individual performance factors in middle school and the proximal outcome of being on track at the end of the ninth grade was also analyzed. The moderation effect of student background factors was examined to determine if individual performance factors varied when those characteristics applied to specific groups of students. The following research questions that guided this study were:

- Q1 How do the individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades predict that a student will drop out of high school?
- Q1A Do these associations vary according to student background variables (i.e., gender, free or reduced-priced lunch (FRL) status, race and ethnicity, disability status, English language learner (ELL) status)?



- Q2 How do the individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades predict that a student will graduate on time from high school?
- Q2A Do these associations vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status)?
- Q3 How do the individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades predict that a student will be on track to graduate at the end of the ninth grade (six credits earned and no failing grades in math or English)?
- Q3A Do these associations vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status)?
- H1 The individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades have no predictive relationship to dropping out of high school.
- H1A These associations do not vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status).
- H2 The individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades have no predictive relationship to graduating on time.
- H2A These associations do not vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status).
- H3 The individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades have no predictive relationship to being on track to graduate at the end of the ninth grade (six credits earned and no failing grades in math or English).
- H3A These associations do not vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status).

### **Method**

This longitudinal study was based upon a quantitative, correlational research design. A quantitative research approach is often recommended to researchers who intend to explain why something occurred through trend analysis and the subsequent examination of trend-based variability (Creswell, 2015). Quantitative research questions are built around quantifiable, measurable, and observable data related to the studied variables (Creswell, 2015). In this study,

an analysis of trends and variability among subjects was completed as part of a statistical analysis designed to answer specific research questions in alignment with Creswell (2015). Correlational research was employed to determine “the tendency or pattern for two (or more) variables or two sets of data to vary consistently” (Creswell, 2015, p. 338). The analysis of background factors required correlation tests that uncovered the impact of background factors on other variables and the relevant outcomes. Extracting the early warning indicators (EWI) from studies conducted in urban contexts and other past research and statistically testing those in a suburban setting called for quantitative research questions.

This study was conceptualized to provide educators with specific data about the extent of individual student performance indicators correlated with the most and least favorable high school outcomes and to clarify how individual student background factors moderated the performance indicators. Variables are said to co-vary when the performance of one variable can be predicted by the performance of another variable (Creswell, 2015). The independent variables in this study were statistically analyzed based on sixth, seventh, and eighth-grade data to determine which factors significantly correlated to each of the three dependent variables.

As noted in the literature review, prior research clearly shows that middle school indicators as early as the sixth grade can be used to predict high school outcomes. Middle school indicators were consistently more predictive of ninth-grade performance than high school outcomes, and ninth-grade indicators were more predictive than middle school indicators of high school outcomes (Easton et al., 2017; Hillman, 2014; Kieffer & Marinell, 2012). A robust review of previous studies led to the decision of the researcher to test middle school predictors and determine the strength of their correlation to being on track to graduate at the end of the ninth

grade. The three dependent variables for this study were graduating on time, dropping out of high school, and being on track to graduate at the end of the ninth grade.

Further, previous studies (Balfanz et al., 2012; Easton et al., 2017; Hernandez, 2011; Hillman, 2014; Gwynne et al., 2012; Kieffer & Marinell, 2012) informed the decision to include the individual performance variables of course performance, engagement, and discipline.

Individual background variables were defined as gender, FRL status, race and ethnicity, disability status, and ELL status, which were also selected according to an extensive review of the relevant literature.

Binomial logistic regression was chosen as the statistical analysis approach to answer these research questions. It was selected as the most accurate analytical method to predict the probability that an observation (independent variable) would fall into one of two categories of a dichotomous dependent variable (Agresti & Finlay, 2009). In this study, independent variables were statistically tested to determine their correlation to three dichotomous dependent variables. A final binomial logistic regression model was defined as the model that best fit the data from this sample, meaning this model most successfully answered the research question.

### **Procedures**

An application for the approval of research involving human subjects was completed and approved by the Information Review Board (IRB) and the University of Northern Colorado. The IRB approval process for the participating school district was also completed, and their requirements for data integrity were followed, as Creswell (2015) recommended. Protecting the anonymity of the student information was paramount (Creswell, 2015), and several suggested measures were utilized to ensure anonymity. Disruption to the school district was minimized as much as possible, a key ethical consideration (Creswell, 2015). The only possible disruption this

research caused was the additional workload for central office staff, who assisted with data retrieval, data scrubbing, and data integrity questions. Because this study was comprised of a secondary data analysis, researcher bias was minimized.

### **Sample**

A sample is defined as a subset of the population from which data were collected and analyzed (Agresti & Finlay, 2009). The researcher was interested in studying how individual performance factors in middle school predicted high school outcomes in a suburban Colorado setting. This section describes the sample for this study, including the setting, data sources and handling, data integrity, sampling, and sample characteristics.

### **Setting**

Data collection was completed in a suburban Colorado school district, which was given the pseudonym River Vista School District (RVSD) for confidentiality purposes. RVSD has been designated by the National Center for Education Statistics (n.d.) as a suburban small school district (code 23). NCES defines this designation as a territory inside an urbanized area but outside a principal city, with a population of less than 100,000 (NCES, n.d.). Non-probability sampling was employed since this school district was selected due to availability, and the study addressed a gap in the literature related to the lack of studies on suburban settings (Creswell, 2015). Convenience sampling means subjects were chosen because they represented the characteristic being studied, were accessible to the researcher, and were willing and able to participate (Creswell, 2015). RVSD voluntarily participated, and thus this district selection can be classified as a convenience sample (Creswell, 2015). Pupil enrollment statistics for RVSD represented the graduation year of the cohort studied. For the 2018–19 school year, student enrollment was between 25,000 and 35,000; 49% female, 51% male; and 27% of the total

student body participated in the FRL program. The race and ethnicity composition of RVSD was 0.3% American Indian or Alaskan Native, 3% Asian, 0.8% Black or African American, 30% Hispanic or Latino, 63% White, 0.1% Native Hawaiian or Other Pacific Islander, and 3% two or more races (CDE, n.d.). Past studies have emphasized the importance of tailoring the EWS to observational data in local districts (Therriault, O’Cummings, Heppen, Yerhot, & Scala, 2013; Therriault, O’Cummings, Heppen, Yerhot, Scala, & Perry, 2013), so convenience sampling of the district did not reduce the reliability or validity of the results. The sample for this study was taken from one Colorado school district, and the results could be generalized to the RVSD population and other districts that share similar demographic characteristics.

Due to statewide school closures related to the COVID-19 pandemic in March 2020, the most recent high school graduating class that had a traditional, uninterrupted school year was the class of 2019, and therefore the students in this study were those in the school district with an on-time graduation projected for May 2019. The cohort that represented the graduation and dropout rates for the class of 2019 was formed when those students entered high school as ninth-grade students in August 2015. Decisions were made to include and exclude students from this sample based on meeting the purpose of ensuring the sample represented a longitudinal study of sixth grade through 12<sup>th</sup> grade.

After the initial cohort was established, students remained in the sample if they were enrolled continuously in the district from sixth grade through the time they were assigned a high school end status. Students who left and enrolled in another school district were removed from the sample since their enrollment in high school continued in a different school district. Students new to the Colorado Department of Education (CDE) adjusted cohort graduation rate (ACGR) cohort after the ninth grade were excluded from the sample for this study since data on their

performance indicators from sixth through eighth grades was not available. Students remained in the sample even if they transferred to other schools within RVSD. All students in the sample had identical graduation requirements.

At RVSD, 24.5 total credits were required for high school graduation in 2019, including 4.0 credits of English language arts and 3.0 credits of math in Algebra 1 classes or higher (RVSD website, unpublished confidential data). The dependent variable of graduating on time in RVSD was defined as earning the 24.5 required credits, including the required core and elective credits, and completing an Individual Career and Academic Plan. According to CDE, a graduate for the class of 2019 had until August 31, 2019, to meet the requirements of the local school district and be coded a four-year, on-time graduate (CDE, n.d.). Graduates were coded as such when RVSD reported high school end status to CDE in a required annual report (CDE, n.d.). Each student who met the requirements for high school graduation by the end of the summer following their fourth year of high school was defined as an on-time graduate or “graduate.”

### **Data Sources and Handling**

The data procured for this study was housed in RVSD’s Infinite Campus (I.C.) student data management system. The dependent variable data related to high school end status (graduated on time or dropped out) and the data that defined the proximal outcome of on-track for graduation at the end of the ninth grade was housed in I.C. The outcome variable on-track to graduate at the end of the ninth grade was defined as no failing course grades in English language arts or math and at least six credits earned in the ninth grade—referred to as *on-track status* in this study. All variables were coded and defined in the Statistical Package for Social Sciences (SPSS) in conjunction with the district data technician. RVSD confidentially coded all student data, thus ensuring that any personally identifiable information was removed.

The researcher worked with a district data technician to answer questions about data errors and missing data, and the data technician verified information or corrected data as needed. Data for this study was kept secure on a locked desktop and in a locked data file accessible only to the researcher and the district data technician. Justification for every student record excluded from the sample was clearly documented in writing by the researcher. These measures ensured confidentiality for students, schools, and the school district.

### **Data Integrity**

Data integrity information and processes included in this section were self-reported by administrative staff in the RVSD. Teachers recorded secondary course grades in the online district platform Schoology, and grades were automatically uploaded into I.C. nightly (RVSD, unpublished confidential data). Parents and students had access to grades at all times and could raise questions about grades directly with teachers or school administrators. Student GPA was calculated automatically and uniformly across the district in I.C. based on a preprogrammed weighting system. Course and assignment grades were determined and archived by teachers, and students or parents had the opportunity to raise questions to teachers or administrators about the accuracy and fairness of grades assigned each grading period.

Student attendance record-keeping was mainly the responsibility of teachers, who marked students in attendance or tardy (late) for each class (RVSD, unpublished confidential data). Registrars and attendance clerks at each school in RVSD ensured attendance was recorded in I.C., and they corrected or updated data as needed on an ongoing basis. Annual training was provided to registrars, attendance clerks, and school administrators by the district Data Quality Manager, who also maintained a blog with training tools accessible at all times. School administrators trained teachers on attendance procedures. The reasons for student absences were

mainly reported to the school registrar by the parent or guardian of the student, and accuracy was dependent on self-reporting by the guardian. Students sent home due to illness or for disciplinary reasons were coded by the school as excused. Parents and students of RVSD could view daily attendance at all times and raise questions about attendance accuracy directly with school staff. Attendance record-keeping was the primary responsibility of teachers and school office staff.

The district Student Attendance and Engagement Department monitored attendance rates for each school on a weekly basis and worked directly with school staff to ensure attendance was taken properly (RVSD, unpublished confidential data). Additionally, school administrators and counselors monitored attendance rates monthly, if not more often, to address excessive absences and ensure that staff followed attendance procedures. The RVSD Data Quality Manager reported attendance to CDE annually and worked directly with school staff to verify and correct data for integrity and accuracy. School staff had support from RVSD district staff for the task of maintaining accurate attendance data.

Disciplinary incidents were recorded in I.C. by school administrators and registrars. The district Data Quality Manager conducted annual training on reporting disciplinary incidents in I.C., and ongoing communication and training were provided as needed (RVSD, unpublished confidential data). Supporting documents with detailed directions regarding entering discipline-related data correctly into I.C. were available to staff. The district Data Quality Manager reported disciplinary incidents to CDE annually and worked directly with school staff to make corrections to ensure accuracy. Principals in RVSD accessed reports that summarized results from data checks against I.C. to correct missing or erroneous data. School administrators had some discretion to respond to office referrals, and the absence of a matrix dictating required responses to all behavior likely led to inconsistencies among schools, administrators, and teachers. RVSD



school board policy defined the scope of discipline and consequences that could result in suspensions and expulsions. School and district staff shared the responsibility for the accurate reporting of disciplinary incidents.

High school end status was reported in I.C. by high school registrars, high school administrators, and the district Data Quality Manager (RVSD, unpublished confidential data). The RVSD Data Quality Manager provided annual training to school staff, and supporting documents were available to school staff for reference throughout the school year. Principals were provided annual reports to review, and they updated high school end status information through required documentation and verified any changes. The district Data Quality Manager reported high school end status to CDE annually and, in that process, directly worked with registrars and school administrators to ensure accuracy and make necessary corrections. The District Data Manager provided reports to high school principals about graduating class cohorts and required data verification. Data checks were conducted for end status codes monthly at the district level, and CDE required three levels of data quality checks in the end-of-year report that the district Data Quality Manager submitted. The RVSD Data Quality Manager and school staff shared the responsibility for accurate high school end status tracking.

RVSD reported both school and district-level oversight for data quality. District-level administrators, school principals, and other school staff members were responsible for the accurate reporting of disciplinary actions, attendance, grades, and high school end status. Ongoing training and communication occurred to ensure data quality and integrity, as reported by district officials in RVSD.

## **Sampling and Sample Characteristics**

Non-probability sampling was used in this study. A school district was asked and agreed to participate voluntarily, and all subjects in the targeted group who met the predetermined rules for the study were included. A larger sample size helps reduce sampling bias (Agresti & Finlay, 2009). The recommended sample size for binomial logistic regression analysis is 500, represented by  $n=500$  (Bujang et al., 2018). The sample size for this study was 1,268 students, and this study was a secondary data analysis of data previously collected by the participating school district. Descriptive statistics tables were included in this study to illuminate the characteristics of the sample.

## **Measures**

A student in this study was considered to have dropout status (cohort dropout status) or graduate status (ACGR) from RVSD using CDE definitions and guidelines. Any student who left RVSD before completing high school for any reason, except death, and who did not transfer to another school or a home study program was classified as a dropout (CDE, n.d.). Students earned a high school diploma by satisfying local requirements for coursework and assessments within four years of starting the ninth grade (CDE, n.d.). This timeframe included the summer following the fourth year of high school, meaning August 31 following the fourth year (CDE, n.d.). If a student death occurred in the selected sample, or a student disenrolled from school due to illness or injury or was incarcerated, that record was removed.

Any students who remained in the sample and had a high school outcome other than on-time graduation or dropping out were kept in the sample and coded accordingly. Examples of

high school outcomes outside of graduation or dropped out included students who were retained and intended to return the following year as a fifth-year senior, enrollment in a GED program, or enrollment in a vocational education program outside of the district. Therefore, the district graduation rate for the class of 2019 did not match the graduation rate for the sample for this study.

### **Dependent Variables**

Three dependent variables for this study were included in the model. They included graduated from high school on time (yes, no), dropped out of high school (yes, no), and on track for graduation at the end of the ninth grade (yes, no). On-track status at the end of the ninth grade was a proximal outcome included in the study since prior research suggested individual performance factors in middle school had a stronger association with ninth-grade outcomes than high school outcomes.

### **Independent Variables**

The independent variables were categorized as individual performance variables, and individual background variables were also tested for their moderating effect on the performance variables. The individual performance variables were tested to determine which were most accurate for use in the final model. The individual performance variables were the number of failing course grades for each middle-grade year in English language arts, the number of failing course grades for each middle-grade year in math, combined GPA in core subjects (English language arts, math, science, and social studies) by school year, the number of failing grades by quarter for all core subjects combined, the number of total days absent in a school year regardless of reason, and the number of disciplinary incidents resulting in an office intervention in a school year.

A failing grade was defined as “F,” with the range of grades from high to low being “A,” “B,” “C,” “D,” and “F.” Middle schools in RVSD were comprised of grades six through eight, and all middle schools recorded course grades on a quarter system (RVSD website, unpublished confidential data). The individual performance variables were statistically screened for strength to determine which variables to include in the final models.

The individual background moderators were gender (female = 1, male = 0), FRL status (yes, no), disability status (yes, no), and ELL status (yes, no). The race and ethnicity background moderators included in this study were those reported to CDE by school districts, including American Indian or Alaskan Native (yes, no), Asian (yes, no), Black or African American (yes, no), Hispanic or Latino (yes, no), White (yes, no), Native Hawaiian or Other Pacific Islander (yes, no), and two or more races (yes, no). Once the individual performance variables were screened for strength, their association to the dependent variables was tested to determine if the dependent variables were substantially altered by the individual background variables.

### **Variable Codes**

Variables were coded, put into data sets, and recorded in SPSS. The binomial logistic regression analyses and related analyses testing the moderating effect of background factors were performed in SPSS. Coding was determined for the independent variables, and variable codes were summarized in Table 3.1.

**Table 3.1***Variable Codes*

Type of Variable	Variable Description	Categorical		Continuous
		Yes	No	
Independent	Number of ELA course failures <sup>a</sup>			0, 1, 2, 3, 4
Independent	Number of math course failures <sup>b</sup>			0, 1, 2, 3, 4
Independent	Number of core course failures <sup>c</sup>			0-16
Independent	Core GPA by school year			0.00-4.00
Independent	Absences per grade level exceeds 10% <sup>d</sup>	1	0	
Independent	Disciplinary incidents per grade level <sup>e</sup>			0-...
Independent-Moderator	Gender <sup>f</sup>	1	0	
Independent-Moderator	FRL <sup>g</sup>	1	0	
Independent-Moderator	American Indian or Alaskan Native	1	0	
Independent-Moderator	Asian	1	0	
Independent-Moderator	Black or African American	1	0	
Independent-Moderator	Hispanic or Latino	1	0	
Independent-Moderator	White	1	0	
Independent-Moderator	Native Hawaiian or Other Pacific Islander	1	0	
Independent-Moderator	Two or more races	1	0	
Independent-Moderator	Disability <sup>h</sup>	1	0	
Independent-Moderator	English language learner <sup>i</sup>	1	0	
Dependent	Graduate <sup>j</sup>	1	0	
Dependent	Dropped out <sup>k</sup>	1	0	
Dependent	On track in ninth grade: No course failure in ELA or math and 6.0 or more credits earned	1	0	

*Note.* This table demonstrates the type of variable, provides a description, and shows how the variable was coded in SAS.

<sup>a</sup> English language arts (ELA) quarterly grades per school year. <sup>b</sup> Quarterly grades per school year. <sup>c</sup> Core courses include ELA, math, science, and social studies and exclude intervention and elective courses. <sup>d</sup> RVSD definition of chronic absence. <sup>e</sup> Disciplinary incidents reported in whole numbers for each incident requiring administrator intervention, regardless of the severity of the disciplinary consequences. <sup>f</sup> Gender was coded 1 = Female and 0 = Male. <sup>g</sup> FRL was coded for students who qualified for a free or reduced-price lunch (FRL) under the National School Lunch Program. <sup>h</sup> Disability was coded for students who held an active IEP during a school year. <sup>i</sup> English language learner was coded for students actively monitored as ELL during a school year. <sup>j</sup> Graduate was coded for students included in the annual CDE report of ACGR. <sup>k</sup> Dropped out was coded for students included in the annual CDE report as cohort dropout status.

## **Individual Performance Variables**

Individual performance variables were thoughtfully coded. An extensive literature review informed the selection of individual performance factors proposed for this study, and the RVSD provided data for each of the selected performance factors.

### ***Course Performance***

Several course-performance variables were requested for screening by the researcher and were based on the findings of past studies. English language arts course failures were defined continuously by the number of failures on final quarterly grades and ranged from zero to four in a school year. Math course failures were defined continuously by the number of failures on final quarterly grades and ranged from zero to four in a school year. Course grades were assigned on the following scale in RVSD: 90 to 100% equaled “A,” 80 to 89.9% equaled “B,” 70 to 69.9% equaled “C,” 60 to 69.9% equaled “D,” and any percentage below 60% equaled an “F” (RVSD, unpublished confidential data).

GPA was defined as a continuous variable. RVSD used a 4.0 grading scale, where 4.0 was deemed a letter grade of “A,” 3.0 to 3.99 equaled “B,” 2.0 to 2.99 equaled “C,” 1.0 to 1.99 equaled “D,” and .99 or lower equaled “F” (RVSD, unpublished confidential data). RVSD middle school students could not earn a GPA higher than 4.0. However, high school students could earn up to a 4.5 GPA if they enrolled in weighted advanced courses (RVSD, unpublished confidential data). Middle school GPA in the core subjects of math, English language arts, science, and social studies was evaluated for the correlation to dropout status (BERC, 2011).

Core GPA was defined as an average GPA for English language arts, math, science, and social studies courses combined in a school year. Due to limitations in SPSS, a GPA of 0 to 0.99 was coded “1,” 1.0 to 1.99 equaled “2,” 2.0 to 2.99 equaled “3,” 3.0 to 3.99 equaled “4,” and 4.0

equaled “5.” Several course-performance variables were tested for accuracy to determine which was the strongest course-performance predictor of graduating on time, and therefore was used in the final models.

### ***Engagement***

Engagement was defined by the number of days a student was absent in a school year for any reason. The website for RVSD defined chronic absenteeism as missing 10% or more days in a school year (RVSD, unpublished confidential data). RVSD students attended school for 174 days per school year, therefore missing 17 or more days represented 10%, which was considered chronically absent (RVSD, unpublished confidential data). The National High School Center has consistently recommended that middle schools and high schools use a 10% absence rate as the threshold to determine who is off track for graduating from high school (Therriault, O’Cummings, Heppen, Yerhot, & Scala, 2013; Therriault, O’Cummings, Heppen, Yerhot, Scala, & Perry, 2013). Absences in a year equating to less than 10% were coded “0,” and absences equating to 10% or more days were coded as “1,” regardless of the reason for the absence. Chronic absences, or missing 10% or more days of school in a year, served as a proxy for student engagement in this study.

### ***Discipline***

The number of disciplinary incidents students experienced in a school year was coded as a continuous variable and depicted by whole numbers regardless of the seriousness of the infraction or the extent of the disciplinary response. In RVSD, disciplinary responses entered into I.C. ranged from a principal intervention to expulsion from the school district (RVSD, unpublished confidential data). Examples of principal interventions included a call to a parent or

restorative action by the student. This independent variable overlapped somewhat with the engagement variable since some disciplinary responses resulted in suspension (absence) from the classroom or school.

The way in which students experience discipline at school is largely driven by the beliefs, attitudes, and biases of the staff and administrators of the school (Welsh & Little, 2018). While the literature review revealed how past studies have discussed this individual performance factor as a student-level factor related to the behavior students exhibit in the school environment, more recent studies have suggested that the prevalence of disciplinary incidents was a school-level factor related to school culture, meaning how staff and administrators prevent and respond to misbehavior (Welsh & Little, 2018). While disciplinary incidents were defined for this study by the number of referrals to the school office, this number was influenced by factors outside the control of students, including staff and administrator bias, school culture, and teacher skill level and commitment to including rather than excluding students from the classroom.

### **Individual Background Variables**

An extensive review of the literature guided the selection of individual background variables included in this study. RVSD provided data for each of the selected background variables, which were defined and coded accordingly.

#### ***Gender***

Gender was defined as male or female (RVSD, unpublished confidential data) and self-reported by the parents of students. Male gender was coded as “0,” and female gender was coded as “1.”



### ***Free and Reduced-Price Lunch Status***

FRL status included students who qualified for a free or reduced-price lunch under the National School Lunch Program. The FRL variable was coded as no equals “0” or yes equals “1.”

### ***Race and Ethnicity***

Race and ethnicity categories reflected the CDE reporting requirements. Parents answered questions to self-report the race and ethnicity of their students when they initially enrolled them in school. Race and ethnicity categories were coded as American Indian or Alaskan Native “no” equaled “0” or “yes” equaled “1,” Asian “no” equaled “0” or “yes” equaled “1,” Black or African American “no” equaled “0” or “yes” equaled “1,” Hispanic or Latino “no” equaled “0” or “yes” equaled “1,” White “no” equaled “0” or “yes” equaled “1,” Native Hawaiian or Other Pacific Islander “no” equaled “0” or “yes” equaled “1,” and two or more races “no” equaled “0” or “yes” equaled “1.”

### ***Disability Status***

Disability status included any student identified to have an active IEP. The variable disability status was coded as “no” equaled “0” or “yes” equaled “1.”

### ***English Language Learner Status***

ELL status included any student identified as ELL during a school year and was coded “no” equaled “0” or “yes” equaled “1.”

### ***Dependent Variables***

Three dependent variables were tested in this study. A graduate, meaning a student who graduated on time, was coded as “1” if they graduated or “0” if they failed to graduate on time.

Students who dropped out after entering high school and before their on-time graduation date were coded as “1,” with “0” meaning a student did not drop out. Students on track to graduate at the end of the ninth grade were defined as having no failing course grades in ELA or math and earning at least six credits, and they were coded as “1” if they were on track to graduate or “0” if they were not.

### **Statistical Analysis**

The statistical analysis for this study has been organized according to the three phases of preliminary analysis, logistic regression analysis, and testing the moderation effects. Any analysis of secondary data requires an explanation of how variables affect each other, as the manner in which variables were defined and how the research questions were phrased determines the statistical analysis (Creswell, 2015). The research questions informed the final definitions of the variables and the statistical tests selected.

### **Preliminary Analysis**

The binomial logistic regression approach required that some assumptions were met and others mitigated through additional statistical tests. According to Laerd Statistics (n.d.), six assumptions must be considered or met. The first two assumptions must be met to proceed with this model, and the final four, if they fail, identify the need for further statistical testing (Laerd Statistics, n.d.). These assumptions are as follows:

1. The dependent variable should consist of two categorical, independent (unrelated) groups (i.e., a dichotomous variable).
2. There are two or more independent variables, which should be measured at the continuous or nominal level.

3. There should be independent observations, which means that there is no relationship between the observations.
4. The data must not show multicollinearity, which occurs when two or more independent variables are highly correlated.
5. There needs to be a linear relationship between any continuous independent variable and the logit transformation of the dependent variable.
6. There should be no significant outliers, high leverage points, or highly influential points, which represent observations in the data set that are in some way unusual.  
(Laerd Statistics, n.d.)

All three dependent variables in this study were categorical, dichotomous, and met assumption one. There were more than two independent variables in this study, satisfying assumption two. Assumption three was addressed through the determination of  $p$ -values for the coefficient tests (Laerd Statistics, n.d.). Substantial changes in coefficients when a predictor variable was added to the model indicated multicollinearity (Laerd Statistics, n.d.). This result can lead to a Type II error or a failure to reject the null hypothesis when it should be rejected (Laerd Statistics, n.d.). Variables were tested for collinearity, and where collinearity existed, one of the variables was excluded or otherwise mitigated in order to meet assumption four. The dependent variables were categorical and binary outcomes, linearizing the relationship (Agresti & Finlay, 2009) and satisfying assumption five.

Assumption six was also mitigated. The power of a binary hypothesis test was reflected by the probability that the null hypothesis was rejected correctly (Agresti & Finlay, 2009). The power of the analysis was represented as  $(1-\beta)$  and improved with increased accuracy in rejecting the null hypothesis or reducing the likelihood of a Type I error and the power of a test

(Welkowitz et al., 2011). Per Welkowitz et al. (2011) and Agresti and Finlay (2009), the researcher set the criterion of significance for this study at alpha 0.05, or  $\alpha = 0.05$ , and beta was at 0.20 or a power of 0.80.

The sample size was unknown at the start of this study, and after thorough data scrubbing, a final sample size of 1,268 was achieved. Peduzzi et al. (1996) found that the numbers of events per predictive variable could become too small to predict the outcome variable reliably, and when this number fell below ten, it was problematic in a logistic regression model. When the events per variable were ten or greater, Peduzzi et al. (1996) stated that no problems occurred. As the events per predictive variable decreased, the bias of the regression coefficients increased (Peduzzi et al., 1996). Bujang et al. estimated a sample size of 500 or more for logistic regression analysis to ensure insignificant differences between the sample estimate and the overall population (2018). The assumptions were met for this study through the study design and statistical testing.

### **Logistic Regression**

Binomial logistic regression, commonly referred to as logistic regression, was chosen over multiple regression analysis due to the dependent variables being defined dichotomously (Agresti & Finlay, 2009). Multiple regression analysis is used when the dependent variable is continuous (Agresti & Finlay, 2009). While multinomial logistic regression is an extension of logistic regression, it was not used since it required the dependent variable to have more than two categories (Agresti & Finlay, 2009).

Logistic regression predicts the probability that independent variables will fall into one category or another (Agresti & Finlay, 2009). Probability values were assigned “0” or “1,” with

“0” equal to “no” and “1” equal to “yes” (Agresti & Finlay, 2009). The following equation was used to build the model to address research questions Q1, Q2, and Q3 for this study:

$$P (y=1) = \frac{e^{\alpha + b_i X_i}}{1 + e^{\alpha + b_i X_i}}$$

where:

$p$  = the probability that a case was in a particular category,

$\exp$  = the base of the natural logarithms (2.72),

$\alpha$  = the constant of the equation,

$b_i$  = the coefficient of the predictor variables,

$X_i$  = predictor variables, and

$X_i$  predicted the probability of  $Y$ .

Logistic regression was used to build a model to best fit or predict the dependent variables ( $Y$ ) from the data collected from the RVSD.

### **Testing the Moderation Effect**

Binomial regression analysis involved finding the statistical model that best fit the data analyzed, also known as the goodness of fit (Agresti & Finlay, 2009). Three statistical tests were performed that informed the goodness of fit for the final models. In this study, individual background variables were included to test the effect of the individual performance variables on each of the outcomes. Statistical interactions in logistic regression analysis occur if the relationship between one predictor variable and outcome depends on the interaction with another predictor variable (Agresti & Finlay, 2009). When this transpires, the second predictor variable is said to moderate the effect of the first predictor variable on the outcome (Agresti & Finlay,

2009). Testing the interaction was added to the model to address research questions 1A, 2A, and 3A. The likelihood-ratio test of independence, Wald statistic, and Nagelkerke's  $R^2$  were used for this purpose (Allison, 2014; Agresti & Finlay, 2009).

The likelihood-ratio test is an approximate chi-square statistic where the degrees of freedom ( $df$ ) are determined by the number of additional parameters in the full model (Agresti & Finlay, 2009). The following formula for the likelihood-ratio test of independence was applied to test the interaction of independent variables (Agresti & Finlay, 2009):

$$-2 \log\left(\frac{\ell_0}{\ell_1}\right) = (-2\log \ell_0) - (-2\log \ell_1),$$

where:

-2 times the log of the ratio = approximation of a chi-squared distribution,

$\log$  = the logistic regression of this ratio,

$\frac{\ell_0}{\ell_1}$  = the log of the ratio of the null hypothesis to the alternative hypothesis,

$\ell_0$  = the maximum of the likelihood function when the null hypothesis is true, and

$\ell_1$  = the maximum of the likelihood function when the alternate hypothesis is true.

The likelihood-ratio test compared the fit of two models.

The Wald chi-square test, or Wald statistic, was used to test the significance of each independent variable in the model. The Wald statistic predicted the probability of associating with a category based on a change in an independent variable when all other variables were held constant (Laerd Statistics, n.d.). The Wald statistic was used to determine the strength of the association of each variable and the interaction effect of the predictor variables on the outcome variables.

Pseudo  $R^2$  values were used to understand how much variation in the outcome variable was explained by the model (Laerd Statistics, n.d.). The proportion of the total variation in the

dependent variable, as explained by the predictive power of all the explanatory variables, was represented by Nagelkerke's  $R^2$  (Laerd Statistics, n.d.). The researcher used SPSS to calculate Nagelkerke's  $R^2$ .

In summary, the statistical test used in this study was binomial logistic regression. The independent variables related to individual performance factors were tested to determine their individual strength. In addition, the individual background variables were tested to determine if they changed the association between the independent performance variables and the outcome variables. This interaction effect was reported. A binomial logistic regression approach was used to test three different outcome variables at each grade level, sixth through eighth.

### **Limitations**

As Creswell (2015) noted, all research has limitations that may distort the subsequent results, and researchers need to identify those clearly as weaknesses in the study. One methodological limitation in this study was the use of non-probability sampling to determine the participating school district (Agresti & Finlay, 2009). Inferences with non-probability samples have unknown reliability and validity, which can result in sampling bias (Agresti & Finlay, 2009).

Once the school district was chosen for the study, the sample of student records for this longitudinal study was a subset of all students who attended this district and eventually achieved a high school outcome. Thus, students excluded from the study had a high school outcome that was not analyzed. Missing data, part-time students, and students who moved in or out of the district represented additional limitations. These records were removed from the study, and the verification of those individual decisions was documented. Because this project used a longitudinal study design, the final sample represented a subset of students who never moved out

of the district or entered from another district in the seven years between the beginning of sixth grade through the CDE deadline for on-time graduation on August 31, 2019.

Another limitation of this study was that the number of disciplinary incidents a student experienced could have been more a function of teacher bias, classroom management, or the ability of teachers to form strong relationships with all students rather than an individual performance factor controlled by the student. The same limitation applied to school attendance. Poor attendance may result from factors outside the control of students, such as family or external environmental factors or poor relationships with teachers. This study was also limited by the accuracy of the data the participating school district housed and shared from their databases.

### **Chapter Summary**

The purpose of this study was to determine through statistical modeling the independent variables that accurately predicted which middle school students graduated on time, dropped out of high school, and were on track for graduation at the end of the ninth grade. This longitudinal analysis of one cohort of students followed them from sixth grade through the end of high school, yielding information about when the demonstration of the independent performance variables caused students to fall off track for graduation. Therefore, the study resulted in a recommended timeline for when an intervention should be considered to set students on a course for on-time graduation. The individual background variables were also analyzed to provide information about how student background factors impacted individual performance factors. Prior research indicated that individual performance factors in middle school predicted ninth-grade performance more than high school outcomes. This finding prompted the inclusion of data to determine which independent variables most accurately predicted a student was on track for graduation at the end of the ninth grade.



The value of this study is manifold. The information garnered can provide the basis for a comprehensive early warning system whereby a school or school district similar to RVSD can systemically collect and routinely analyze key performance data to provide appropriate and timely interventions for students. Increasing the likelihood of on-time high school graduation sets students on a course for better life outcomes compared to students who require more than four years to graduate or drop out altogether. As noted elsewhere, high school outcomes are linked to several long-term individual and societal repercussions.

## CHAPTER IV

### FINDINGS

The purpose of this study was to determine which middle school level individual performance factors accurately predicted high school outcomes and identified students who were on track to graduate on time at the end of the ninth grade. Individual performance factors for course performance, chronic absences, and the number of disciplinary incidents were applied as predictor variables. Four academic variables were tested within course performance to determine the strongest predictor for the model: course failures in English language arts, course failures in math, course failures in core subjects, and grade point average (GPA) in core subjects.

Once the course-performance predictor variable was selected, it was analyzed in combination with the two other predictor variables of chronic absence status and the number of disciplinary incidents. Then the moderation effect was analyzed for the individual background variables of gender, free and reduced-price lunch status (FRL), race and ethnicity, disability status, and English language learner (ELL) status. This analysis was completed for grades six, seven, and eight using data from a longitudinal cohort of students during the school years 2012–13, 2013–14, and 2014–15.

Three binary outcome variables were tested: on-track status at the end of the ninth grade, dropout status, and graduated status. The outcome variable of on-track at the end of the ninth grade was defined as earning six academic credits with no failing grades in English language arts or math on the report card. Binomial logistic regression analyses were completed to test the

ability of individual performance variables to predict the three outcome variables. Additional binomial logistic regression models were run that measured the moderation effects of the individual background factors on the initial models.

The logistic regression analysis and descriptive statistics were generated using the Statistical Package for Social Sciences (SPSS). Research question one related to the outcome variable dropout status. As a result, the first set of logistic regression models tested the three predictor variables of course performance, chronic absence status, and the number of disciplinary incidents in the sixth, seventh, and eighth grades. Then the moderation effects of gender, FRL status, race and ethnicity, disability status, and ELL status were analyzed to determine how these predictor variables moderated the effect of the performance variables on dropout status. The second set of logistic regression models repeated this process for research question two, but with the outcome variable of graduated status. A third set of logistic regression tests was conducted on the individual performance variables related to the third research question outcome variable: being on the graduation track at the end of the ninth grade. The moderation effects of the background variables were tested as well. Prior to performing statistical analysis, data screening was completed.

### **Data Screening**

Data screening occurred, and the assumptions for binomial logistic regression were checked. The initial raw data set with 1,527 subjects was provided by River Vista School District (RVSD). A data technician from RVSD accepted the data request from the researcher to create a Microsoft Excel file of the subjects in the sample. The technician removed students not continuously enrolled in RVSD from the beginning of the sixth grade through the end of high

school. The data request for this study also stipulated that students be excluded if they left the school district to enroll in homeschool instruction, charter schools, or a public school outside of the participating school district.

Further, students were removed from the sample if they passed away or had to discontinue school due to illness or injury. These decisions aligned with the Colorado Department of Education rules for including or excluding students from graduation cohorts. For the data request for this study, students remained in the sample if they were continuously enrolled beginning in the sixth grade and then moved to other public schools within RVSD. They also remained in the sample if their high school end status included dropped out, graduated on time, retained for a fifth year of high school, enrolled in a general educational development (GED) program, or enrolled in an occupational or vocational training program not administered by the school district such as Job Corps.

The researcher further screened the data of the 1,527 subjects for errors, and 225 subjects were removed due to moving out of RVSD and then back into the district. Another 34 subjects were removed due to their end status as disenrolled due to illness or injury, transfer to a Colorado public school, transfer to a Colorado private school, transfer to home school instruction, or transfer to the Department of Corrections. Other screening for errors occurred for each of the data points requested. The RVSD data technician provided a data file with each background factor coded as 1 = yes and 2 = 0. Additional corrections were made for FRL and individualized education plan (IEP) status in seventh grade, where the initial data file provided to the researcher coded all students as 1 = yes for FRL and IEP. The data technician corrected this information, and all of the other grade-level data were rechecked and determined to be accurate.

Assumptions must be met or mitigated for binomial logistic regression to consider the results of this statistical test for analysis (Laerd Statistics, n.d.). The first assumption was that the outcomes be dichotomous and categorical (Laerd Statistics, n.d.), and all three outcomes for this study met the assumption. The outcome variables were coded by RVSD using the end-of-year reports required by the Colorado Department of Education (RVSD, n.d.). Dropout status was 1 = yes and 0 = no, graduated status was 1 = yes and 0 = no, and on track at the end of the ninth grade was coded by the researcher as 1 = yes and 0 = no. For the outcome on track in ninth grade, RVSD provided three data points for every ninth-grade student in the sample: number of course failures in English language arts, number of course failures in math, and the total number of credits earned at the end of the ninth grade. Previous studies revealed that as little as one course failure in ninth grade was linked to dropping out and being classified as credit deficient at the end of the ninth grade (Allensworth & Easton, 2007; Allensworth et al., 2014; Easton et al., 2017; Neild & Balfanz, 2006). In RVSD, 24.5 credits were required for graduation; therefore, students who earned six credits in ninth grade were deemed on track to graduate (RVSD, n.d.). The researcher coded students with no course failures in English language arts or math and who earned six or more credits as 1 = yes and 0 = no for the outcome variable on-track at the end of the ninth grade, ensuring that the first assumption for binomial logistic regression was met.

The second assumption Laerd Statistics (n.d.) outlines for binomial logistic regression was that there should be two or more independent variables, either continuous or categorical. This study included three independent performance variables and five background factor variables. The third assumption clarifies the requirement of independent observations (Laerd Statistics, n.d.). Each of the 1,268 students in the study sample was included only once, meeting the independent observations assumption.

The fourth assumption outlined by Laerd Statistics (n.d.) states that the variables should not be highly correlated with each other or show a high degree of multicollinearity, meaning that two or more independent variables clearly show that a change in one is associated with a change in the other (Laerd Statistics, n.d.). This result causes a lack of clarity as to which independent variable contributed to explaining the outcome variable (Laerd Statistics, n.d.). To test this assumption, the correlations between the individual performance factors were tested. The results are displayed in Table 4.1. Then the correlations between the individual background variables were tested (see Table 4.2). Eighth-grade data were used to test for multicollinearity since the study results revealed that the most robust models for predicting the outcome variables were based upon eighth-grade data.

**Table 4.1**

*Correlation of Individual Performance Variables Using Eighth-Grade Data*

		Core GPA	Disciplinary incidents	Chronic absence status
Core GPA	Pearson Correlation	1	-.304**	-.151**
	Sig. (2-tailed)		.000	.000
	N	1268	1268	1268
Disciplinary incidents	Pearson Correlation	.000	1	.107**
	Sig. (2-tailed)	-.304**		.107**
	N	1268	1268	1268
Chronic absence status(1)	Pearson Correlation	-.151**	.107**	1
	Sig. (2-tailed)	.000	.000	
	N	1268	1268	1268

\*\*Correlation is significant at the 0.01 level (2-tailed).

**Table 4.2***Correlation of Individual Background Variables Using Eighth-Grade Data*

		White(1)	Hisp or Lat(1)	ELL(1)	Disab(1)	FRL(1)	Gender(1)
White(1)	Pearson Correlation	1	-.874**	-.692**	-.050	-.697**	-.023
	Sig. (2-tailed)		.000	.000	.073	.000	.417
	N	1268	1268	1268	1268	1268	1268
Hisp or Lat(1) <sup>a</sup>	Pearson Correlation	-.874**	1	.696**	.056*	.698**	.012
	Sig. (2-tailed)	.000		.000	.047	.000	.680
	N	1268	1268	1268	1268	1268	1268
ELL(1) <sup>b</sup>	Pearson Correlation	-.692**	.696**	1	.045	.993**	-.001
	Sig. (2-tailed)	.000	.000		.107	.000	.984
	N	1268	1268	1268	1268	1268	1268
Disab(1) <sup>c</sup>	Pearson Correlation	-.050	.056*	.045	1	.043	-.088**
	Sig. (2-tailed)	.073	.047	.107		.124	.002
	N	1268	1268	1268	1268	1268	1268
FRL(1) <sup>d</sup>	Pearson Correlation	-.697**	.698**	.993**	.043	1	-.002
	Sig. (2-tailed)	.000	.000	.000	.124		.930
	N	1268	1268	1268	1268	1268	1268
Gender(1) <sup>e</sup>	Pearson Correlation	-.023	.012	-.001	-.088**	-.002	1
	Sig. (2-tailed)	.417	.680	.984	.002	.930	
	N	1268	1268	1268	1268	1268	1268

*Note.* <sup>a</sup> Hispanic or Latino. <sup>b</sup> English Language Learner Status. <sup>c</sup> Disability Status. <sup>d</sup> Free or Reduced-Price Lunch Status. <sup>e</sup> Gender (Female = 1, Male = 0).

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

As shown in Table 4.1, the three individual performance variables—core GPA, number of disciplinary incidents experienced, and chronic absence status—were not significantly correlated. The large sample size for this study meant the study had the statistical power to detect weak correlations that resulted in a significant  $p$  value (Laerd Statistics, n.d.). With correlation calculations, the Pearson correlation coefficient (Pearson's  $r$ ) was used to determine significance in conjunction with the  $p$  values. Pearson's  $r$  coefficient varies between -1.00 to 1.00, with no correlation represented by 0.00 (Laerd Statistics, n.d.). The guidance for the strength of the association between two variables provided by Laerd Statistics (n.d.) was .10 to .30 = small, .31 to .50 = medium, and .51 to 1.0 = large.

Table 4.1 also illustrates that the associations between the three variables of core GPA, disciplinary incidents, and chronic absence status ranged from -.30 to .11. All associations

between the three independent predictor variables were small; therefore, core GPA, disciplinary incidents, and chronic absence status were not highly correlated. This finding means the contribution of each of these three independent variables to the explanation of the outcome variable was clear. Table 4.2 reveals strong, positive correlations between Hispanic or Latino and ELL status,  $r(1266), = .696, p < .001$ ; Hispanic or Latino and FRL status  $r(1266), = .698, p < .001$ ; and ELL status and FRL status,  $r(1266), = .993, p < .001$ . A positive Pearson's coefficient indicates that, as one variable occurs, so does the other, and a negative coefficient indicates that, as one categorical variable occurs, the other does not (Laerd Statistics, n.d.). The background variable of White had a strong, negative correlation to ELL status,  $r(1266), = -.692, p < .001$ , and FRL status,  $r(1266), = -.697, p < .001$ . There was strong multicollinearity between Hispanic and Latino, ELL status, and FRL status.

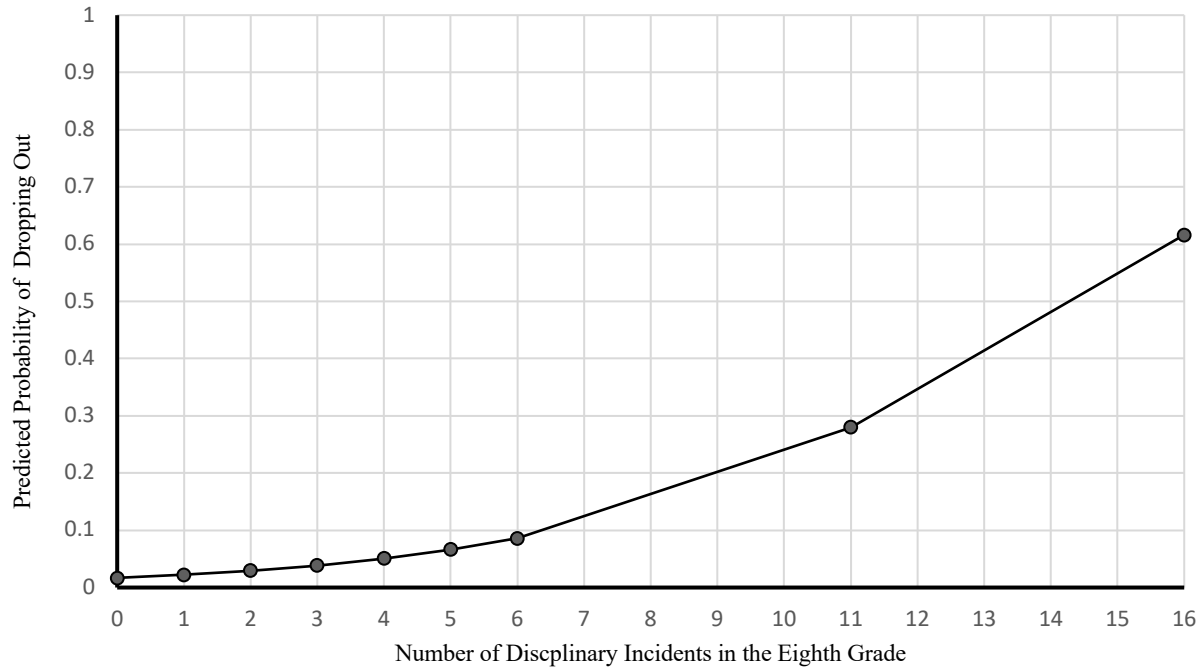
To mitigate the impact of multicollinearity in this study and better understand the impact of each individual background variable, dummy variables were created that isolated each independent variable (Laerd Statistics, n.d.). Numerous multiple linear regression models were tested to ensure each individual background variable was analyzed separately (Laerd Statistics, n.d.). This result mitigated the impact of multicollinearity on the test results. For example, students were coded 1 = yes and 0 = no for the background variable of ELL status. Then ELL status was added as an interaction term to each of the models that tested the outcome variables. As shown in Table 4.2, a positive and significant correlation was identified between the background variables of ELL and Hispanic or Latino,  $\chi^2(1, N = 1268) = 0.99, p < .001$ . The ELL status variable was tested in a separate logistic regression model from the Hispanic or Latino variable. The individual background variables were tested independently from one another using logistic regression models.



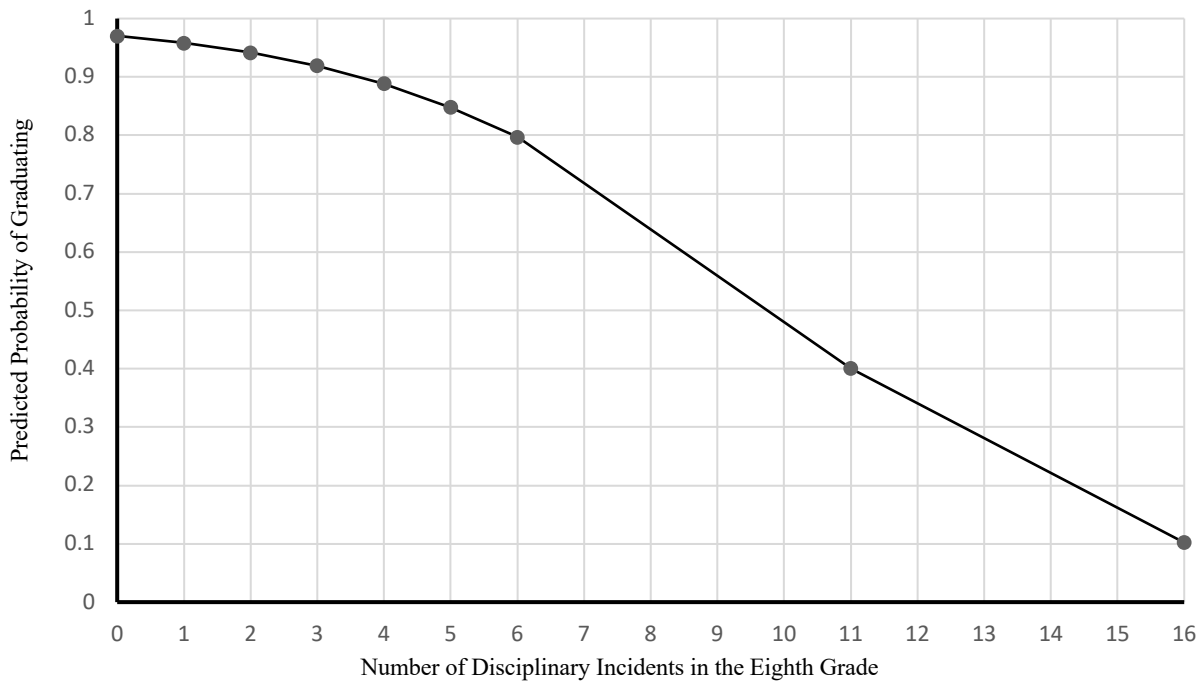
Binomial logistic regression analysis requires a linear relationship between the outcome variables and any continuous independent variables that are unbounded (Laerd Statistics, n.d.). Core GPA was treated as a continuous variable; however, each subject in the study was assigned to one of five core GPA bounded categories. No student could be assigned a core GPA category below 1.00 (F) or above 5.00 (A). The single, unbounded independent variable in this study was the number of disciplinary incidents students experienced each school year. Since the eighth-grade models were the most significant of the three grade levels for all three outcome variables, eighth-grade discipline data were analyzed for linear relationships. Figure 4.1 is a scatter plot of eighth-grade discipline and the dependent variable of dropout status. Figure 4.2 is a scatter plot of eighth-grade discipline and graduated status, and Figure 4.3 is a scatter plot of eighth-grade discipline and the status of on-track in the ninth grade. The scatter plots in Figures 4.1, 4.2, and 4.3 depict a mostly linear relationship with the exception of two possible outliers for dropout status, graduated status, and on-track status. These two outliers were one student who experienced 11 disciplinary incidents and another who experienced 16 disciplinary incidents in one school year.

**Figure 4.1**

*Scatter Plot: Predicted Probability of Dropout Status and Eighth-Grade Discipline*

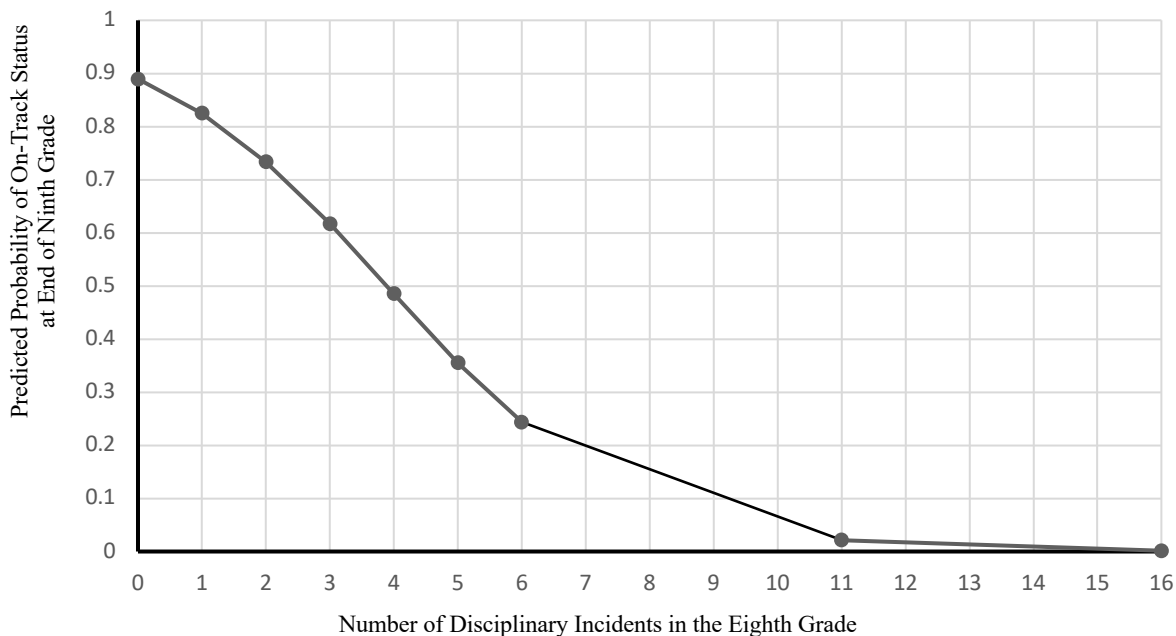
**Figure 4.2**

*Scatter Plot: Predicted Probability of Graduated Status and Eighth-Grade Discipline*



**Figure 4.3**

*Scatter Plot: Predicted Probability of On-Track at the End of Ninth Grade and Eighth-Grade Discipline*



The two outlier subjects were removed from the eighth-grade discipline sample, and three logistic regression analyses were run using eighth-grade data (core GPA, disciplinary incidents, and chronic absence status) for three outcome variables (dropped out, graduated, on-track in ninth grade). The Nagelkerke  $R^2$  for each outcome was 0.199 for dropout status, 0.192 for graduated status, and 0.368 for on-track in ninth grade. For all three outcomes, the eighth-grade model with a sample size of 1,266 remained the best fit, with the Nagelkerke  $R^2$  remaining the largest in eighth grade compared to the seventh and sixth-grade models, which had sample sizes of 1,268. No other notable changes to the statistical results emerged when the two outlier subjects for disciplinary incidents in eighth grade were removed. This analysis revealed that the two outliers did not have a notable impact on the study conclusions, and the logistic regression analysis results were reported with the outliers included.

The final assumption for binomial logistic regressions requires that no significant outliers exist for continuous, unbounded variables (Laerd Statistics, n.d.). The only continuous, unbounded variable in this study was the number of disciplinary incidents. The linear relationship analysis for the previous assumption provided the basis to determine whether the assumption requiring no significant outliers was met. Since no notable changes to the Nagelkerke  $R^2$  occurred when the two outliers were removed from the sample, it was determined that there were no significant outliers, and this assumption was met.

The data set was reviewed for accuracy and met the requirements for this study. Once completed, descriptive statistics were examined to understand the characteristics of the sample. Assumptions for binomial regression analyses were met through the study design, including the issues that emerged related to multicollinearity. Finally, statistical testing occurred, and it was determined that there were no significant outliers.

### **Descriptive Statistics**

Bujang et al. (2018) recommended a sample size of at least 500 for binomial regression analyses. The sample size for this study was 1,268 and considered a robust sample size for binomial logistic regression. Descriptive statistics were generated for the sample and reported for the individual performance variables, individual background variables, and dependent variables.

#### **Individual Performance Variables**

Four course-performance variables were examined to select one to include in the logistic regression models: the number of failing grades in English language arts, the number of failing grades in math, the number of failing grades in core subjects, and the core subject GPA. River Vista middle school students were assigned report card grades every quarter, and a course grade

of “F” was considered failing. All other grades signified passing a course. The core subjects included English language arts, math, science, and social studies.

Descriptive statistics illuminated the distribution of grade failures by grade level.

The number of failing course grades in English language arts by grade level is displayed in Table 4.3. As the students included in this study progressed through middle school, they earned more failing grades in English language arts. More than 11% of all grades earned in the eighth grade in English language arts were failing grades, compared to 3.2% in the sixth grade. The number of failing course grades in math by grade level is depicted in Table 4.4. Almost 14% of all math grades earned in the eighth grade were failing grades, compared to 6.7% in the sixth grade.

**Table 4.3**

*Number of Course Failures in English Language Arts in Grades Six, Seven, and Eight*

Number of Fs	Sixth Grade			Seventh Grade			Eighth Grade		
	Frequency	Percent	Number of Fs	Frequency	Percent	Number of Fs	Frequency	Percent	
0	1227	96.8	0	1174	92.6	0	1124	88.6	
1	25	2.0	1	62	4.9	1	83	6.5	
2	10	0.8	2	22	1.7	2	32	2.5	
3	6	0.5	3	6	0.5	3	18	1.4	
4	0	0.0	4	4	0.3	4	11	0.9	
Totals	1268	100		1268	100		1268	100	

*Note.* The number of Fs is the number of failing course grades on the report card out of four possible grades.

**Table 4.4***Number of Course Failures in Math in Grades Six, Seven, and Eight*

Sixth Grade			Seventh Grade			Eighth Grade		
Number of Fs	Frequency	Percent	Number of Fs	Frequency	Percent	Number of Fs	Frequency	Percent
0	1183	93.3	0	1166	92	0	1093	86.2
1	57	4.5	1	51	4	1	80	6.3
2	14	1.1	2	28	2.2	2	31	2.4
3	10	0.8	3	12	0.9	3	36	2.8
4	4	0.3	4	11	0.9	4	28	2.2
Totals	1268	100		1268	100		1268	100

*Note.* The number of Fs is the number of failing course grades on the report card out of four possible grades.

The number of course failures in core subjects by grade level is displayed in Table 4.5.

Course failures increased in frequency as this cohort progressed from sixth to eighth grade.

Almost 25% of the cohort earned one or more course failures in core subjects in the eighth grade, while only about 12% earned core subject course failures in the sixth grade. This pattern resembled those of math and English language arts course failures.

**Table 4.5***Number of Course Failures in Core Subjects in Grades Six, Seven, and Eight*

Sixth Grade			Seventh Grade			Eighth Grade		
Number of Fs	Frequency	Percent	Number of Fs	Frequency	Percent	Number of Fs	Frequency	Percent
0	1114	87.9	0	1058	83.4	0	958	75.6
1	74	5.8	1	80	6.3	1	116	9.1
2	36	2.8	2	40	3.2	2	57	4.5
3	15	1.2	3	27	1.7	3	24	1.9
4	10	0.8	4	21	1.7	4	25	2.0
5 to 16	19	1.5	5 to 16	42	3.3	5 to 16	113	8.9

*Note.* The number of Fs is the number of failing course grades on the report card out of four possible grades.

The fourth course-performance variable was core GPA, defined as the GPA of all grades earned in English language arts, math, science, and social studies classes in one school year. The

mean GPA in core subjects for sixth-grade students was 3.10 out of 4.00, with a range of 0.14 to 4.00 and a standard deviation of 0.78. For seventh-grade students, the mean was 3.03, with a range of 0.25 to 4.00 and a standard deviation of 0.84. In the eighth grade, the mean GPA was 2.88, with a range of 0.06 to 4.00 and a standard deviation of 0.90. Core GPA data mirrored course failure data insofar that, as students progressed through middle school, more students earned a lower GPA in the core subjects.

Core GPA data were then grouped into letter grade ranges, a format familiar to educators, students, and parents. It was statistically analyzed in these groupings and treated as a continuous variable. A core GPA of “F” consisted of all GPA values between zero and 0.99, “D” was one to 1.99, “C” was two to 2.99, “B” was three to 3.99, and “A” was 4.00. In SPSS, these groups were assigned numeric values of F = 1.00, D = 2.00, C = 3.00, B = 4.00, and A = 5.00. When core GPA was organized into categories, the mean GPA in sixth grade was 3.62, with a range of 1.00 to 5.00 and a standard deviation of 0.82. In the seventh grade, the mean was 3.58, with a range of 1.00 to 5.00 and a standard deviation of 0.89. In the eighth grade, the mean core GPA was 3.41, with a range of 1.00 to 5.00 and a standard deviation of 0.93. All four course-performance variables were statistically tested, and the results informed the final decision of which to include in the logistic regression model bundle for the research questions.

Beyond course performance, the remaining two individual performance variables were the number of absences and the number of disciplinary incidents students experienced in a school year. The number of absences was determined to be chronic by RVSD if students missed more than 17 days in a school year, the equivalent of 10% or more days. Among sixth-grade students, 58 (4.6%) were chronically absent, and 1,210 (95.4%) were not. In the seventh grade, 75 (5.9%)

students were chronically absent, and 1,193 (94.1%) were not. Among eighth-grade students, 108 (8.5%) were chronically absent, and 1,160 (91.5%) were not.

The third individual performance variable in this study was the number of disciplinary incidents students experienced each school year. Disciplinary incidents for this study were defined as a staff response to a student that required the student to speak with a school administrator. In RVSD, staff decisions to refer students to the office were documented in the Infinite Campus student data management system. Among the 1,268 students in the sixth-grade sample, 1,097 (86.5%) experienced no disciplinary incidents, and 171 (13%) experienced one to 18 incidents. In the seventh grade, 1,118 (88.2%) students experienced no disciplinary incidents, while the remaining 150 (11.8%) students experienced one to 15 incidents. For students in the eighth grade, 1,122 (88.5%) experienced no disciplinary incidents, and the other 146 (11.5%) students experienced one to 16 incidents. The number of disciplinary incidents resulting in a visit to the school office remained stable from sixth through eighth grade for this sample.

The three individual performance variables of course performance, chronic absences, and disciplinary incidents were described above. Between 86% and 88% of students experienced no disciplinary incidents as they progressed from sixth to eighth grade. Chronic absenteeism increased slightly from sixth to eighth grade. Regarding all course-performance variables, students earned more failing grades each year they progressed from sixth to eighth grade. The remaining predictor variables were individual background factors analyzed for their interaction effect on the course-performance variables.

### **Individual Background Variables**

Descriptive statistics for individual background variables were generated, including gender, FRL status, race and ethnicity, disability status, and ELL status. Most variables were



quantified for each grade, six through eight, when the background factor had the potential to change from year to year.

The gender balance of the sample remained relatively unchanged in the longitudinal data, with 640 (50.5%) female and 628 (49.5%) male students. The FRL status of the sample revealed a decline in qualifications for FRL throughout the middle grades: 425 (33.5%) qualified for FRL in the sixth grade, 383 (30.2%) in seventh grade, and 302 (23.8%) in eighth grade. Race and ethnicity data were reported once for the entire sample when students were enrolled in the sixth grade. A frequency analysis of the sample revealed that 807 (63.6%) students identified as White, 380 (30%) Hispanic or Latino, 43 (3.4%) Asian, 15 (1.2%) Black or African American, 12 (0.9%) two or more races, six (0.5%) American Indian or Alaskan Native, and five (0.4%) Native Hawaiian or Other Pacific Islander. RVSD reported race and ethnicity together as one unit. White and Hispanic or Latino students represented 1,187 out of 1,268 students, 93.6% of the sample. As noted elsewhere, a small sample size increases sampling bias (Agresti & Finlay, 2009). Due to the low number of students in most racial and ethnic categories (range of five to 43 subjects per category), only White and Hispanic or Latino were analyzed as predictor variables. For example, students identified as White were compared to students in all other race and ethnicity categories combined. In the same way, students identified as Hispanic or Latino were compared to students from all other race and ethnicity categories. Students from all race and ethnic categories were included in the sample for this study even though only White and Hispanic or Latino were analyzed as predictor variables.

The remaining two individual background variables were disability status and ELL status. A disability status of “yes” indicated a student had an IEP that resulted in direct services in special education. This variable remained stable over the course of middle school, with 125

(9.9%) students on an IEP in sixth grade, 132 (10.4%) in seventh grade, and 126 (9.9%) in the eighth grade. For ELL status, 295 (23.3%) students qualified for these services in the sixth grade, 183 (14.4%) in the seventh grade, and 299 (23.6%) in the eighth grade. This fluctuation in the percentage of the sample considered ELL was surprising. The district data technician confirmed the accuracy of the ELL data.

In sum, an examination of the predictor variables over the three middle school years revealed stable percentages for most variables. Course performance, FRL status, and ELL status were the least stable variables. Course performance gradually declined through middle school as measured by an increase in the number of failing course grades. The percentage of students who qualified for FRL services also declined by about 10% from sixth to eighth grade. English language learner status dipped from about 23% in sixth grade to 14% in seventh grade and then rebounded to about 23% in the eighth grade.

### **Logistic Regression Analysis**

A binomial logistic regression analysis was conducted in SPSS to test each hypothesis. This analysis predicted the probability that an observation would fall into one of two outcomes for each research question. After descriptive statistics were analyzed, a logistic regression analysis occurred. First, the two formats for core GPA were statistically tested to determine if one or the other was stronger after organizing core GPA into categories. Even when divided into five categories by letter grade, this variable was treated as continuous. Then the four course-performance variables were tested to determine which was the strongest predictor of the outcome variable of graduating on time. The selected course-performance variable, chronic absence status, and the number of disciplinary incidents were grouped and tested using a binomial

logistic regression analysis for each outcome variable. Finally, the individual background variables were analyzed to determine how they moderated the effect of the individual performance variables on the outcome variables.

### **Course-Performance Variable Analysis**

Core GPA in each grade level of middle school was treated as a continuous variable. A binomial regression analysis was conducted to compare core subject GPA with core subject GPA grouped into letter grade categories, as previously defined. One model was built using sixth, seventh, and eighth-grade core GPA to predict the dependent variable of graduating on time. The Nagelkerke  $R^2$  for this model was 0.214, which meant this set of predictor variables explained 21.4% of the variance in graduated status. Then the model was built using the core GPA by letter grade categories and the outcome of graduating on time. The Nagelkerke  $R^2$  for this model was 0.213, indicating that 21.3% of the variance in graduated status was explained by this set of predictor variables. The logistic regression results were nearly the same, and core GPA grouped into categories was selected to be the GPA variable tested among all variables for course performance. Henceforth, this variable is referred to as core GPA.

The second course-performance analysis compared course failures in English language arts, course failures in math, core subject course failures, and core GPA. The binomial logistic regression model was analyzed for sixth, seventh, and eighth-grade course failures in ELA and graduated status. The result was significant,  $\chi^2(3, N = 1268) = 34.51, p < .001$ . The Nagelkerke  $R^2$  was 0.105, meaning about 10.5% of the variance in graduated status was explained by ELA course failures in the sixth, seventh, and eighth grades. The next logistic regression was performed in the same manner but with the predictor variables of math course failures in the sixth, seventh, and eighth grades. The results were significant,  $\chi^2(3, N = 1268) = 27.47, p <$

0.001, and the Nagelkerke  $R^2$  was 0.084. Then core subject course failures were analyzed with all grade levels in the model using graduated status. These results were significant,  $\chi^2(3, N = 1268) = 47.22, p < 0.001$ , and the Nagelkerke  $R^2$  was 0.143. Finally, core GPA was analyzed with logistic regression using data from all three grade levels and graduated status, and the result was significant at  $\chi^2(3, N = 1268) = 70.03, p < 0.001$ . The Nagelkerke  $R^2$  was 0.213. Based on the Nagelkerke  $R^2$ , core GPA was the strongest predictor of graduated status among the four course-performance variables.

A logistic regression analysis of the course-performance variables informed the decision of which variables to include in the model for the research questions. Subsequently, core GPA, chronic absences, and the number of disciplinary incidents were analyzed for the extent they predicted each of the three dependent variables.

### **Findings: Research Question One**

The first research question was: How do the individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades predict that a student will drop out of high school? The three individual performance variables of core GPA (continuous variable), chronic absence status (categorical variable), and the number of disciplinary incidents (continuous variable) were entered into a binomial logistic regression model along with the outcome variable of dropout status. The logistic regression for all research questions was designed to test core GPA, chronic absence status, and the number of disciplinary incidents as a bundle in predicting each outcome variable.

Using the significance criterion of  $\alpha = .05$ , the three predictor variables were entered into a binomial logistic regression model with the outcome variable dropout status. The statistical analysis of each independent variable related to dropout status when they were not considered

together in the equation can be viewed in Table 4.6. In isolation, most independent variables were significant using a significance criterion of  $\alpha = .05$  with the exceptions of chronic absence in sixth grade and disciplinary incidents in seventh grade.

**Table 4.6**

*Independent Variables Not in the Equation for Dropout Status by Grade Level*

Sixth Grade	Sig.	Seventh Grade	Sig.	Eighth Grade	Sig.
Core GPA	.000	Core GPA	.000	Core GPA	.000
Disciplinary incidents	.000	Disciplinary incidents	.186	Disciplinary incidents	.000
Chronic absence(1)	.373	Chronic absence(1)	.024	Chronic absence(1)	.029

When the independent variables were tested in the equation, several of the significance levels changed for independent variables. However, core GPA remained significant for every grade level. The significance values of the three individual performance factors when combined into one logistic regression equation to predict dropout status by grade level are presented in Table 4.7.

**Table 4.7**

*Significance of Individual Performance Variables by Grade Level for Dropout Status*

		<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>Sig.</i>	<i>Exp(B)</i>	95% C.I. for <i>EXP(B)</i>	
								<i>Lower</i>	<i>Upper</i>
Model 1 <sup>a</sup>	6 Core GPA	-.707	.239	8.724	1	.003	.493	.309	.788
	6 Disc. Inc.	.126	.076	2.757	1	.097	1.135	.977	1.317
	6 Chron. Ab.(1)	-.298	.767	.151	1	.698	.742	.165	3.341
Model 2 <sup>b</sup>	7 Core GPA	-1.248	.230	29.426	1	.000	.287	.183	.451
	7 Disc. Inc.	-.055	.128	.181	1	.671	.947	.736	1.218
	7 Chron. Ab.(1)	-.558	.598	.872	1	.600	.572	.177	1.846
Model 3 <sup>c</sup>	8 Core GPA	-1.247	.227	30.173	1	.000	.287	.184	.448
	8 Disc. Inc.	.038	.107	.125	1	.724	1.039	.842	1.281
	8 Chron. Ab.(1)	-.445	.548	.658	1	.417	.641	.219	1.877

*Note:* Model 1, Model 2, and Model 3 each depict a separate logistic regression analysis, one for each grade level.

<sup>a</sup> The variables analyzed in Model 1 were sixth-grade core GPA, sixth-grade disciplinary incidents, and sixth-grade chronic absence status. <sup>b</sup> The variables analyzed in Model 2 were seventh-grade core GPA, seventh-grade disciplinary incidents, and seventh-grade chronic absence status. <sup>c</sup> The variables analyzed in Model 3 were eighth-grade core GPA, eighth-grade disciplinary incidents, and eighth-grade chronic absence status.

Significant results for each grade level were observed. The sixth-grade model was significant where core GPA was concerned,  $\chi^2(1, N = 1268) = 8.72, p = .003$ . The Nagelkerke  $R^2$  was 0.075, meaning about 7.5% of the variance in dropout status could be explained by the three sixth-grade predictors. The number of disciplinary incidents ( $p = .097$ ) and chronic absence status ( $p = .698$ ) were not significant in the sixth-grade model. The results using individual performance variable data for seventh-grade and dropout status were significant for core GPA,  $\chi^2(1, N = 1268) = 29.43, p < .001$ . The Nagelkerke  $R^2$  was 0.162 for this model, suggesting that about 16% of the variance in dropout status was explained by the three individual performance variables in the seventh grade. The number of disciplinary incidents ( $p = .671$ ) and chronic absence status ( $p = .600$ ) were not significant. Finally, the eighth-grade results were significant for core GPA,  $\chi^2(1, N = 1268) = 30.17, p < .001$ . The Nagelkerke  $R^2$  was 0.187 for the model, demonstrating that almost 19% of the variance in dropout status was explained by the three individual performance variables in eighth grade. The number of disciplinary incidents ( $p = .724$ ) and chronic absence status ( $p = .417$ ) were not significant in the eighth-grade model for dropout status.

For all grade levels, when all three variables were entered simultaneously into the logistic regression model, core GPA was the only one that emerged as significant. The unique predictive value of chronic absence status and the number of disciplinary incidents were not significant after controlling all other variables in the model. Using an established significance level of  $\alpha = .05$  and the Pearson chi-square results for dropout status, the null hypothesis was rejected for research question one.

A closer examination of the odds ratios, or  $\text{Exp}(B)$  on the SPSS output, revealed more information about the extent that core GPA predicted dropout status. Odds describe the

probability of observing a specified target outcome compared to the number of non-occurrences. For every unit increase of sixth-grade core GPA (one letter grade), the odds of dropping out decreased by 51.7% or  $1 - \text{Exp}(B) 0.493 = 0.517$ . For every unit increase for the seventh-grade core GPA, the odds of dropping out decreased by 71.3% or  $1 - \text{Exp}(B) 0.287 = 0.713$ . For every one unit eighth-grade core GPA increased, the odds of dropping out decreased by 71.3% or  $1 - \text{Exp}(B) 0.287 = 0.713$ . Based on the  $p$  values, odds ratio statistics, and Nagelkerke  $R^2$  statistics, seventh and eighth-grade core GPA were nearly equally predictive of dropout status and more predictive than sixth-grade core GPA.

The cross tabulation tables revealed slightly different information for the eighth-grade core GPA and the seventh-grade core GPA results. Tables 4.8 and 4.9 display the expected counts and actual performance, with the difference between the expected and actual numbers slightly higher in the eighth grade than in the seventh grade. More students in eighth grade dropped out than expected for the core GPA categories of 1.00 (F) and 2.00 (D) compared to seventh grade. The differences between expected count and actual performance were minimal between the two grade levels. At a practical level, the seventh and eighth-grade models yielded nearly the same results.

**Table 4.8***Cross Tabulation: Seventh-Grade Core GPA and Dropout Status*

		Seventh-Grade Core GPA					Total	
		1.00(F)	2.00(D)	3.00(C)	4.00(B)	5.00(A)		
Dropout Status <sup>a</sup>	0	Count	16	124	348	602	154	1244
		Expected count	19.6	129.5	350.2	593.5	151.1	1244
		% within dropout	1.3%	10%	28%	48.4%	12.4%	100%
		% within 7 <sup>th</sup> core GPA	80%	93.9%	97.5%	99.5%	100%	98.1%
1	Count	4	8	9	3	0		24
	Expected count	0.4	2.5	6.8	11.5	2.9		24
	% within dropout	16.7%	33.3%	37.5%	12.5%	0.0%		100%
	% within 7 <sup>th</sup> core GPA	20%	6.1%	2.5%	0.5%	0.0%		1.9%
Total	Count	20	132	357	605	154		1268
	Expected count	20	132	357	605	154		1268
	% within dropout	1.6%	10.4%	28.2%	47.7%	12.1%		100%
	% within 7 <sup>th</sup> core GPA	100%	100%	100%	100%	100%		100%

*Note.* <sup>a</sup> Dropout status: 0 = did not drop out, 1 = dropped out.

**Table 4.9***Cross Tabulation: Eighth-Grade Core GPA and Dropout Status*

		Eighth-Grade Core GPA					Total	
		1.00(F)	2.00(D)	3.00(C)	4.00(B)	5.00(A)		
Dropout Status <sup>a</sup>	0	Count	40	152	369	589	94	1244
		Expected count	45.1	159.9	366.9	579.8	92.2	1244
		% within dropout	3.2%	12.2%	29.7%	47.3%	7.6%	100%
		% within 8 <sup>th</sup> core GPA	87%	93.3%	98.7%	99.7%	100%	98.1%
1	Count	6	11	5	2	0		24
	Expected count	0.9	3.1	7.1	11.2	1.8		24
	% within dropout	25%	45.8%	20.8%	8.3%	0.0%		100%
	% within 8 <sup>th</sup> core GPA	13%	6.7%	1.3%	0.3%	0.0%		1.9%
Total	Count	46	163	374	591	94		1268
	Expected count	46	163	374	591	94		1268
	% within dropout	3.6%	12.9%	29.5%	46.6%	7.4%		100%
	% within 8 <sup>th</sup> core GPA	100%	100%	100%	100%	100%		100%

*Note.* <sup>a</sup> Dropout status: 0 = did not drop out, 1 = dropped out.

Each of the three grade-level models predicted dropout status with 98.1% accuracy. For all three models, only core GPA significantly impacted the prediction. The model correctly predicted 1,244 (98.1%) student outcomes for each of the three grades and incorrectly predicted 24 (1.9%) student outcomes. For all grade levels, the models predicted that no students would



drop out of high school. In reality, however, 24 students did drop out. This was a false-negative rate of  $0/(24 + 0) = 0\%$  and a false-positive rate of  $24/(24 + 1,244) = 1.9\%$ . The sensitivity for all three models was  $0/(0+24) = 0\%$ , and the specificity for all three models was  $1,244/(1,244 + 24) = 98.1\%$ .

### **Findings Research Question 1A**

The individual background factors were analyzed for their moderation effect on the predictor variables using the dependent variable of dropout status. This analysis answered the second research question: Do these associations vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status)? The Wald chi-square and Nagelkerke  $R^2$  statistics were analyzed to identify background factors that significantly moderated the individual performance factors. The six background factors tested were gender, FRL status, White, Hispanic or Latino, disability status, and ELL status. The interaction effect of each background variable was tested for each grade level. When the background variables were analyzed in the logistic regression model as interactions with core GPA, chronic absences, and the number of disciplinary incidents, three background factors were found to have statistically significant interaction effects.

Using the significance criterion of  $\alpha = .05$ , the six background variables were entered into the logistic regression model to test the effect of their interaction with the main predictors. The variables core GPA, disciplinary incidents, chronic absence, and the outcome variable dropout status were entered into a logistic regression equation with each of the background variables one at a time. This approach reduced the influence of multicollinearity among the background variables in the statistical results. A separate binomial logistic regression model was tested for each background variable. The unique predictive value of each background variable correlated to

dropout status by grade level is displayed in Table 4.10. In isolation, about half of the background variables were significant, and gender ( $p = .003$ ) and Hispanic or Latino ( $p = .010$ ) were significant at all grade levels.

**Table 4.10**

*Independent Background Variables Not in the Equation for Dropout Status*

Sixth Grade	Sig.	Seventh Grade	Sig.	Eighth Grade	Sig.
Gender(1) <sup>a</sup>	.003	Gender(1)	.003	Gender(1)	.003
FRL(1) <sup>b</sup>	.000	FRL(1)	.217	FRL(1)	.112
White(1)	.067	White(1)	.067	White(1)	.067
Hisp or Lat(1) <sup>c</sup>	.010	Hisp or Lat(1)	.010	Hisp or Lat(1)	.010
Disab(1) <sup>d</sup>	.259	Disab(1)	.311	Disab(1)	.672
ELL(1) <sup>e</sup>	.096	ELL(1)	.008	ELL(1)	.105

*Note.* <sup>a</sup>Gender (Female = 1, Male = 0). <sup>b</sup>Free or Reduced-Price Lunch Status. <sup>c</sup>Hispanic or Latino. <sup>d</sup>Disability Status. <sup>e</sup>English Language Learner Status.

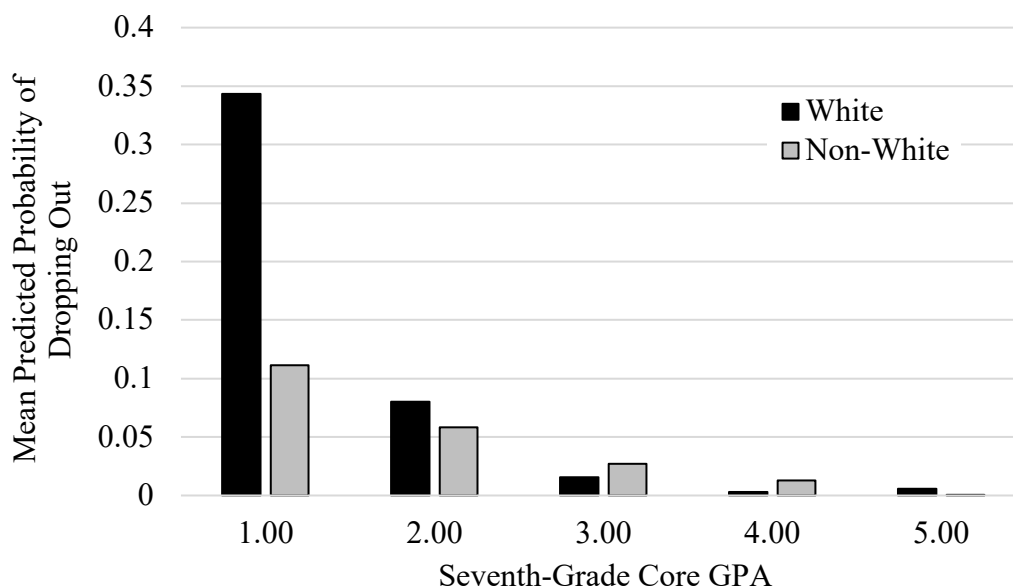
The statistical significance of the background variables changed when analyzed within the logistic regression model with core GPA, disciplinary incidents, and chronic absences. The first significant interaction effect was in sixth grade, where gender differences related to the significance of disciplinary incidents were evident,  $\chi^2(1, N = 1268) = 4.85, p = .028$ . This variable was coded Female = 1 and Male = 0. The odds ratio statistic was examined for the moderation effect of gender on how the number of disciplinary incidents predicted dropping out. Comparing female students who experienced a higher number of disciplinary incidents by one unit to male students whose experience of disciplinary incidents was raised by one unit, there was a 38.8% decrease ( $1 - \text{Exp}(B) 0.612 = 0.388$ ) in the odds of dropping out for females. The gender background factor suggested that when females and males experienced the same number of disciplinary incidents, females were less likely than males to drop out.

The second significant interaction was the background variable White and its impact on core GPA in seventh grade,  $\chi^2(1, N = 1268) = 3.94, p = .047$ . The significance was very close to the criterion of  $\alpha = .05$ . The unstandardized regression weight for the interaction term was a

positive statistic,  $B = .944$ . The positive B statistic implied that as core GPA increased for students who identified as White, their odds of dropping out also increased. Figure 4.4 was constructed to visually demonstrate the relationship of the background variable White and core GPA in the seventh grade through a histogram. Figure 4 visually displays that when students who identified as White with a lower core GPA (1.00, 2.00) were compared to non-White students with a lower core GPA, White students were impacted more positively by every unit increase in core GPA. Though this was a statistically significant finding, the visual of the bar graph aligned with the significance value for the variable seventh-grade core GPA ( $p = .047$ ) almost fell into the insignificant range when the interaction term White was added to the equation. The largest difference between students who identified as White and non-White students in the bar graph was the change from a core GPA of 1.00 to 2.00. For students who identified as White and non-White students in the higher GPA ranges (3.00, 4.00, 5.00), the impact of increasing core GPA by one unit was almost the same. An additional observation was that the predicted probability of dropping out for students identified as White was .34, and for non-White, it was .104 in core GPA category 1.

**Figure 4.4**

*Mean Predicted Probability for Dropout Status: Core GPA and White Status in Seventh Grade*

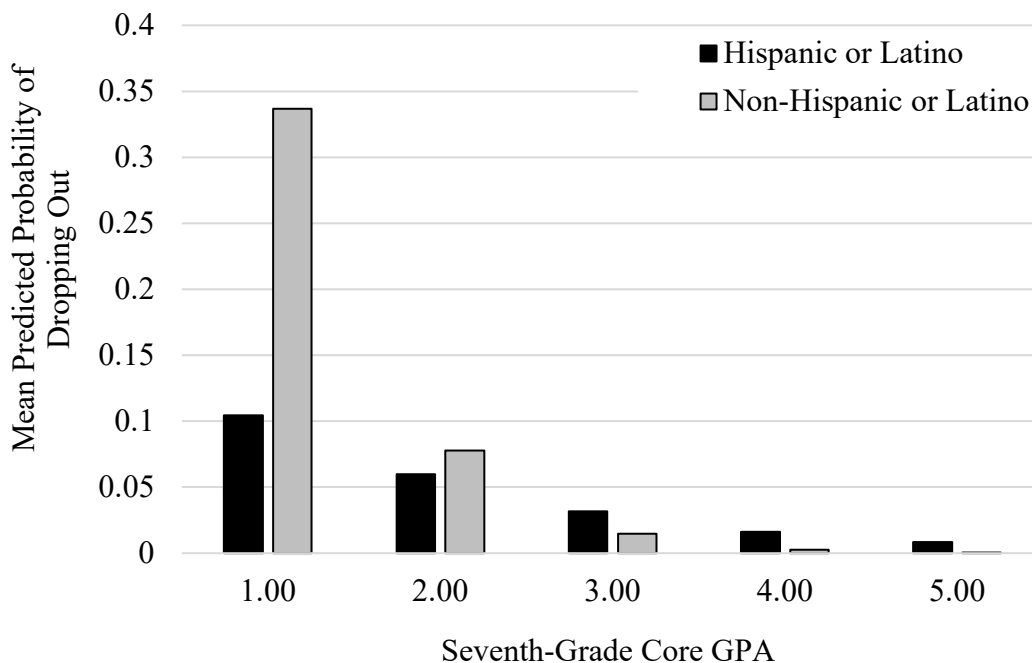


The final significant interaction related to dropout status was the interaction of the background variable Hispanic or Latino with core GPA in the seventh grade,  $\chi^2(1, N = 1268) = 5.05, p = .025$ . The seventh-grade core GPA odds ratio statistic was  $\text{Exp}(B) = 0.337$ , and the unstandardized regression weight for the interaction term was  $B = -1.088$  when the variable White was added as an interaction term to the equation. The negative B statistic revealed that students identified as Hispanic or Latino benefited less than their non-Hispanic or Latino peers for every unit increase in core GPA. Figure 4.5 displays the comparison between Hispanic or Latino students and non-Hispanic or Latino students concerning core GPA in seventh grade and dropout status. One final observation related to Figure 4.5 was that the predicted probability of dropping out for Hispanic or Latino students in the core GPA category 1.00 was .104 compared to .34 for non-Hispanic or Latino. Also, eight out of 807 (1.0%) students who identified as White

earned a GPA of 1.00 compared to 12 out of 385 (3.1%) students who identified as Hispanic or Latino. The number of students earning a core GPA of 1.00 in the seventh grade was small.

**Figure 4.5**

*Mean Predicted Probability for Dropout Status: Core GPA and Hispanic or Latino Status in Seventh Grade*



There were three instances where an individual background variable significantly moderated the individual performance variable on the outcome of dropout status when using a significance criterion set at  $\alpha = .05$ . This shift occurred between gender and disciplinary incidents in sixth grade, White and core GPA in seventh grade, and Hispanic or Latino and core GPA in seventh grade. Therefore, the researcher rejected the null hypothesis for research question 1A.

A binomial regression analysis was conducted with the independent predictor variables of core GPA, the number of disciplinary incidents, and chronic absence status for the outcome of

dropout status in the sixth, seventh, and eighth grades. According to the Nagelkerke  $R^2$  statistics for each grade-level model, the eighth-grade logistic regression model explained the highest percentage of the variance ( $R^2 = 0.187$ ) compared to the sixth ( $R^2 = 0.075$ ) and seventh grade ( $R^2 = 0.162$ ) models. The following equation represented the best fit model from the eighth grade that predicted the odds that a student would drop out using data from the three predictor variables:

$$\text{Eighth Grade: } \frac{P}{1-P} = .916 + .287 (\text{Core GPA}) + 1.039 (\text{Disciplinary incidents}) + .641 (\text{Chronic Absence Status}).$$

An example of how the coefficients in this model predicted the outcome for a specific student was created using a scenario created by the researcher. A hypothetical student in eighth grade with a core GPA of 1.59 (2.00), four disciplinary incidents (4), and no record of chronic absences (0) would have the following equation:

$$\text{Hypothetical Student: } \frac{P}{1-P} = .916 + .287 (2.00) + 1.039 (4) + .641 (0).$$

This hypothetical student would have the odds of  $\frac{P}{1-P} = 5.642$ . So, the odds of this eighth-grade student dropping out were 5.642. In other words, if there were 100 students with similar conditions to this hypothetical student, about 85 would drop out, and only 15 would continue their education.

The eighth-grade logistic regression model was the best fit for this sample, and none of the models accurately predicted the 24 subjects who dropped out in reality. A significance test can be used to examine if the association between the predictor variables and the outcome are different from zero, and as these results demonstrated, there may still be prediction errors. The

models at all three grade levels were 98.1% accurate in predicting who would be associated with not dropping out. Suggestions for the practical use of this information have been included in the implications section.

### **Findings: Research Question Two**

Binomial logistic regression models were constructed to answer the second research question: How do the individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades predict that a student will graduate on time from high school? The three individual performance variables of course performance, chronic absences, and the number of disciplinary incidents were analyzed relative to the outcome variable of graduating from high school on time, also defined as graduated status. The criterion for significance was set at  $\alpha = .05$ .

The three predictor variables were entered into a binomial logistic regression model with the outcome variable graduated status. Table 4.11 presents the statistical analysis of each independent variable related to graduated status when they were not considered together in the equation. In isolation, every background variable was significant for determining graduated status using a significance criterion of  $\alpha = .05$ .

**Table 4.11**

*Independent Variables Not in the Equation for Graduated Status*

Sixth Grade	Sig.	Seventh Grade	Sig.	Eighth Grade	Sig.
Core GPA	.000	Core GPA	.000	Core GPA	.000
Disciplinary incidents	.000	Disciplinary incidents	.000	Disciplinary incidents	.000
Chronic absence(1)	.024	Chronic absence(1)	.003	Chronic absence(1)	.000

When the independent variables were tested in the equation, several of their significance levels changed. Table 4.12 depicts the significance of each of the three individual performance

factors in a logistic regression equation to predict graduated status by grade level. Core GPA was a significant factor in all three grades, just as it was for dropout status.

**Table 4.12**

*Significance of Individual Performance Variables by Grade Level for Graduated Status*

		<i>B</i>	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Model 1 <sup>a</sup>	6 Core GPA	.750	.183	16.724	1	.000	2.117	1.478	3.033
	6 Disc. Inc.	-.141	.066	4.585	1	.032	.869	.764	.988
	6 Chron. Ab.(1)	.708	.515	1.890	1	.169	2.030	.740	5.569
Model 2 <sup>b</sup>	7 Core GPA	1.182	.178	44.004	1	.000	3.260	2.299	4.623
	7 Disc. Inc.	-.056	.073	.596	1	.440	.945	.819	1.090
	7 Chron. Ab.(1)	.637	.464	1.883	1	.170	1.890	.761	4.694
Model 3 <sup>c</sup>	8 Core GPA	1.140	.173	43.414	1	.000	3.128	2.228	4.391
	8 Disc. Inc.	-.071	.094	.564	1	.453	.931	.774	1.121
	8 Chron. Ab.(1)	.851	.538	4.612	1	.032	2.342	1.077	5.094

*Note.* Model 1, Model 2, and Model 3 each depict a separate logistic regression analysis, one for each grade level.

<sup>a</sup> The variables analyzed in Model 1 were sixth-grade core GPA, sixth-grade disciplinary incidents, and sixth-grade chronic absence status. <sup>b</sup> The variables analyzed in Model 2 were seventh-grade core GPA, seventh-grade disciplinary incidents, and seventh-grade chronic absence status. <sup>c</sup> The variables analyzed in Model 3 were eighth-grade core GPA, eighth-grade disciplinary incidents, and eighth-grade chronic absence status.

In the sixth grade, the unique predictive value of chronic absence was not significant after controlling for core GPA and disciplinary incidents. The logistic regression model result was significant for core GPA,  $\chi^2(1, N = 1268) = 16.72, p < .001$ , and the number of disciplinary incidents,  $\chi^2(1, N = 1268) = 4.59, p = .032$ . The chronic absence status result ( $p = .169$ ) was not significant in sixth grade when included in the model with core GPA and the number of disciplinary incidents. When students in the sample were in the seventh grade, the model was significant for core GPA,  $\chi^2(1, N = 1268) = 44.00, p < .001$ . The unique predictive value of the number of disciplinary incidents ( $p = .440$ ) and chronic absence status ( $p = .170$ ) were not significant after controlling for core GPA. In the eighth grade, the particular predictive value of



the number of disciplinary incidents was not significant ( $p = .453$ ) after controlling for all other variables in the model. The eighth-grade logistic regression result was significant for core GPA,  $\chi^2(1, N = 1268) = 43.41, p < .001$ , and chronic absence status,  $\chi^2(1, N = 1268) = 4.61, p = .032$ . The logistic regression models for graduated status were significant at all three grade levels for at least one performance variable using the established significance criterion of  $\alpha = .05$ . Therefore, the null hypothesis was rejected for research question two.

Further examination of the results elucidated the impact of predictor variables on the outcome of graduated status. The Nagelkerke  $R^2$  for the sixth-grade model was 0.10, indicating that 10% of the variance in the outcome of graduating on time could be explained by the combination of the three individual performance variables in the sixth grade. The Nagelkerke  $R^2$  for the seventh grade was 0.18, and for the eighth grade, it was 0.20. It was notable that 20% of the variance in graduated status was explained by the three eighth-grade independent variables of core GPA, number of disciplinary incidents, and chronic absence status.

An analysis of the odds ratio statistic or  $\text{Exp}(B)$  on the SPSS output provided further information about how changes in core GPA impacted the odds of graduating on time. In the sixth grade, for every unit increase of core GPA (one letter grade), there was an increase of 111.7% in the odds of graduating on time ( $\text{Exp}(B) 2.117 - 1 = 1.117$ ). For every unit increase of core GPA in the seventh grade, there was a 226% increase in the odds of graduating on time ( $\text{Exp}(B) 3.26 - 1 = 2.26$ ), and in the eighth grade, there was a 212.8% increase in the odds of graduating on time ( $\text{Exp}(B) 3.128 - 1 = 2.128$ ). Students who improved their core GPA by one unit (one letter grade) substantially improved their odds of graduating on time from high school at all three grade levels.

A further examination assessed the accuracy of these three models in predicting if a student would or would not graduate on time. In the sixth grade, 1,224 student outcomes were predicted correctly (96.5%), and 44 (3.4%) were not. The positive predictive value or specificity of this model for graduated status follows:

$$1,224/(44 + 1,224) = 96.5\%.$$

Core GPA was the only variable to impact the seventh-grade model significantly. The individual performance variables correctly predicted graduated status for 1,225 (96.6%) students, and 43 (3.4%) student outcomes were not accurately predicted. The positive predictive value or specificity of this model follows:

$$1,225/(43 + 1,225) = 96.6\%.$$

In the eighth grade, where core GPA and chronic absence status were both significant, the model correctly made predictions for 1,226 students (96.7%) on the outcome on graduated status, with 42 (3.3%) students forecasted incorrectly. The positive predictive value or specificity of this model follows:

$$1,226/(42 + 1,226) = 96.7\%.$$

For the three grade levels, the incorrect predictions were all attributed to a prediction that the students would graduate, when in actuality, they did not. This resulted in a false-positive rate of 3.4% for sixth grade ( $43/43 + 1,224$ ) and seventh grade ( $43/0 + 1,268$ ), and 3.3% ( $42/42 + 1,225$ ) in eighth grade. The sensitivity of each model was 99.9% ( $1,224/1,224 + 1$ ) in sixth grade, 100% ( $1,225/1,225$ ) in seventh grade, and 99.9% ( $1,225/1 + 1,225$ ) in eighth grade. There were zero false-negative results where the three models predicted students would not graduate, and they actually graduated.

### Findings Research Question 2A

The individual background variables were tested to determine their moderation effect on the individual performance factors related to graduated status. This analysis answered research question 2A: Do these associations vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status)? The Wald chi-square and Nagelkerke  $R^2$  statistics were analyzed to identify background factors that significantly moderated the effect of the individual performance factors on graduated status. The six background factors tested were gender, FRL status, White, Hispanic or Latino, disability status, and ELL status. The interaction effect of each individual background variable was tested within each grade-level logistic regression model.

The six individual background variables were entered separately into a binomial logistic regression model using the significance criterion set at  $\alpha = .05$ . The variables core GPA, the number of disciplinary incidents, chronic absence status, and the outcome variable graduated status were entered into a logistic regression equation with each of the background variables one at a time. This approach mitigated the impact of multicollinearity among the background variables in the statistical results as much as possible. Table 4.13 illustrates the unique predictive value of each background variable for the outcome of graduated status. Each background variable except FRL ( $p = .309$ ) at the seventh-grade level resulted in a statistically significant relationship to the outcome of graduating on time when considered in isolation.

**Table 4.13***Independent Background Variables Not in the Equation for Graduated Status*

Sixth Grade	Sig.	Seventh Grade	Sig.	Eighth Grade	Sig.
Gender(1) <sup>a</sup>	.007	Gender(1)	.007	Gender(1)	.007
FRL(1) <sup>b</sup>	.000	FRL(1)	.309	FRL(1)	.005
White(1)	.017	White(1)	.017	White(1)	.017
Hisp or Lat(1) <sup>c</sup>	.003	Hisp or Lat(1)	.003	Hisp or Lat(1)	.003
Disab(1) <sup>d</sup>	.000	Disab(1)	.000	Disab(1)	.000
ELL(1) <sup>e</sup>	.003	ELL(1)	.000	ELL(1)	.004

*Note.* <sup>a</sup>Gender (Female = 1, Male = 0). <sup>b</sup>Free or Reduced-Price Lunch Status. <sup>c</sup>Hispanic or Latino. <sup>d</sup>Disability Status. <sup>e</sup>English Language Learner Status.

When the background variables were analyzed in the logistic regression model as interactions with core GPA, chronic absences, and the number of disciplinary incidents, two background factors yielded significant results. The background factor of White was significant in both sixth grade,  $\chi^2(1, N = 1268) = 4.11, p = .043$ , and in eighth grade,  $\chi^2(1, N = 1268) = 4.41, p = .036$ , related to chronic absence. Students who identified as White benefited more from changing from chronically absent to not chronically absent when compared to non-White students. Students who identified as White had a 311% increase in the odds of graduating on time if they changed from chronically absent to not chronically absent ( $\text{Exp}(B) 4.11 - 1 = 3.11$ ). In the eighth grade, students who identified as White benefited more than their non-White peers when not chronically absent, improving their odds of graduating by 341% ( $\text{Exp}(B) 4.41 - 1 = 3.41$ ) with this improvement in school attendance.

Finally, disability status was significantly related to core GPA in sixth grade,  $\chi^2(1, N = 1268) = 4.38, p = .036$ , and eighth grade,  $\chi^2(1, N = 1268) = 6.75, p = .009$ . When compared to students without a disability in the sixth grade, there was an increase of 176.7% in the odds of graduating on time for students with a disability when the core GPA increased by one unit ( $\text{Exp}(B) 2.767 - 1 = 1.767$ ). In eighth grade, when comparing students with a disability to

students without a disability, there was a 184.7% increase in the odds of graduating on time for every unit core GPA improved for students with a disability ( $\text{Exp}(B) 2.847 - 1 = 1.847$ ).

Students with a disability in sixth and eighth grades benefited more than their peers without disabilities when their core GPA increased by one letter grade. Based on two background factors with significant interactions at two different grade levels, the researcher rejected the null hypothesis for research question 2A.

Further examination of the Nagelkerke  $R^2$  revealed that none of the background variables increased the variance in the outcome variable as much as FRL status in the sixth grade did for dropout status (6% increase). However, the background variables of White ( $R^2 = .129$ ) and disability status ( $R^2 = .131$ ) increased the variance in graduated status by about 3% more in the sixth grade, according to the Nagelkerke  $R^2$  statistic. The background factors were less impactful in the seventh grade, with only about a 2% increase in the Nagelkerke  $R^2$  statistic for the variables gender and disability status. The Nagelkerke  $R^2$  statistic for the background variables in eighth grade showed they each increased the variance level by about 2%. According to the Nagelkerke  $R^2$  statistics for each grade level model, the eighth-grade logistic regression model explained the highest percentage of the variance ( $R^2 = 0.20$ ) compared to the sixth ( $R^2 = 0.10$ ) and seventh grade ( $R^2 = 0.18$ ) models. The following equation represented the best fit model from the eighth grade that predicted the odds that a student would graduate on time:

$$\text{Eighth Grade: } \frac{P}{1-P} = .541 + 3.128 (\text{Core GPA}) + .931 (\text{Disciplinary incidents}) + 2.342 (\text{Chronic Absence Status}).$$

### **Findings: Research Question Three**

A logistic regression analysis was completed to answer research question three: How do the individual performance variables of course performance, school absences, and the number of

disciplinary incidents in the sixth, seventh, and eighth grades predict that a student will be on track to graduate at the end of the ninth grade (six credits earned and no failing grades in math or English)? The three individual performance variables of course performance, chronic absence status, and the number of disciplinary incidents were analyzed relative to the outcome variable of graduating from high school on time or graduated status. The criterion for significance was set at  $\alpha = .05$ .

Previous studies revealed that as little as one course failure in ninth grade was linked to dropping out, as was a credit deficiency at the end of the ninth grade (Allensworth & Easton, 2007; Allensworth et al., 2014; Easton et al., 2017; Neild & Balfanz, 2006). The parameters for being on track in the ninth grade for this study were that students had earned six credits and had not obtained course failures in math or English language arts on their report cards. The definition of being on track in ninth grade was determined using information from a review of the literature and the participating school district. Prior to reviewing the results of the binary logistic regression analyses for research question three, the researcher verified the relationship between ninth-grade on-track status and the other two outcome variables of dropped out or graduated. This finding was accomplished through a chi-square test of independence.

A chi-square test for independence determines the strength of the relationship between two categorical variables (Laerd Statistics, n.d.). The two assumptions that must be met to perform a chi-square test for independence state that both variables must be categorical and represent independent groups (Laerd Statistics, n.d.). All three outcome variables were dichotomous and categorical, so students were designated as yes = 1 or no = 0 for each. The ninth-grade on-track status was a proximal outcome determined for this sample at the end of the ninth-grade year, and students were designated on the distal outcomes of graduated (yes/no) or

dropped out (yes/no) sometime between ninth grade and end of high school. This result makes the ninth-grade on-track variable independent from graduated status or dropped out status. Both assumptions were met to perform a chi-square test of independence. The results of the chi-square test revealed that ninth-grade on-track status significantly correlated to dropout status,  $\chi^2 (1, N = 1268) = 63.75, p < .001$ . Ninth-grade on-track status also significantly correlated to graduated status,  $\chi^2 (1, N = 1268) = 99.91, p < .001$ .

Logistic regression analyses for research question three were performed. The three predictor variables were entered into a binomial logistic regression model with the outcome variable on-track at the end of ninth grade. Table 4.14 illustrates the statistical analysis of each independent variable related to on-track status when each was considered in isolation. Table 4.14 shows that each background variable was significant for determining on track at the end of ninth grade status using a significance criterion of  $\alpha = .05$ .

**Table 4.14**

*Independent Variables Not in the Equation for On-Track at the End of Ninth Grade*

Sixth Grade	Sig.	Seventh Grade	Sig.	Eighth Grade	Sig.
Core GPA	.000	Core GPA	.000	Core GPA	.000
Disciplinary incidents	.000	Disciplinary incidents	.000	Disciplinary incidents	.000
Chronic absence(1)	.002	Chronic absence(1)	.003	Chronic absence(1)	.001

The individual performance variables (core GPA, number of disciplinary incidents, chronic absence status) were entered into a logistic regression equation with the outcome of on track in ninth grade in grades six, seven, and eight. The results of these statistical tests are shown in Table 4.15. Core GPA proved significant at all three grade levels.

**Table 4.15**

*Significance of Individual Performance Variables by Grade Level for On-Track at the End of Ninth Grade*

		<i>B</i>	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Model 1 <sup>a</sup>	6 Core GPA	1.398	.123	129.197	1	.000	4.047	3.180	5.149
	6 Disc. Inc.	-.010	.057	.029	1	.865	.990	.886	1.107
	6 Chron. Ab.(1)	.434	.355	1.293	1	.222	1.543	.770	3.093
	<hr/>								
Model 2 <sup>b</sup>	7 Core GPA	1.660	.128	168.749	1	.000	5.261	4.095	6.759
	7 Disc. Inc.	.028	.061	.214	1	.644	1.029	.912	1.160
	7 Chron. Ab.(1)	.178	.346	.264	1	.608	1.195	.606	2.355
	<hr/>								
Model 3 <sup>c</sup>	8 Core GPA	1.573	.121	168.723	1	.000	4.823	3.804	6.115
	8 Disc. Inc.	-.068	.096	.498	1	.480	.935	.774	1.128
	8 Chron. Ab.(1)	.170	.299	.322	1	.570	1.185	.660	2.128
	<hr/>								

*Note:* Model 1, Model 2, and Model 3 each depict a separate logistic regression analysis, one for each grade level.

<sup>a</sup> The variables analyzed in Model 1 were sixth-grade core GPA, sixth-grade disciplinary incidents, and sixth-grade chronic absence status. <sup>b</sup> The variables analyzed in Model 2 were seventh-grade core GPA, seventh-grade disciplinary incidents, and seventh-grade chronic absence status. <sup>c</sup> The variables analyzed in Model 3 were eighth-grade core GPA, eighth-grade disciplinary incidents, and eighth-grade chronic absence status.

Results from the logistic regression analysis revealed that the eighth-grade model was the best fit for this sample. In the sixth grade, core GPA was significant,  $\chi^2(1, N = 1268) = 129.20$ ,  $p < .001$ . The particular predictive value of the number of disciplinary incidents ( $p = .865$ ) and chronic absence status ( $p = .222$ ) were not significant after controlling for core GPA. The Nagelkerke  $R^2$  for the sixth grade was 0.252, meaning that the sixth-grade model could explain about 25% of the variance in the outcome of being on track at the end of the ninth grade. Core GPA in the seventh grade was also significant,  $\chi^2(1, N = 1268) = 168.75$ ,  $p < .001$ . After controlling for core GPA, the predictive values unique to the number of disciplinary incidents ( $p = .644$ ) and chronic absence status ( $p = .608$ ) were not significant in seventh grade. The Nagelkerke  $R^2$  for the seventh grade was 0.345, so about 34.5% of the outcome variance was



explained. Core GPA in eighth grade was also significant,  $\chi^2(1, N = 1268) = 168.72, p < .001$ . Once core GPA was controlled for, the unique predictive value of the number of disciplinary incidents ( $p = .480$ ) and chronic absence status ( $p = .570$ ) were not significant in the eighth grade. The Nagelkerke  $R^2$  for the eighth grade was 0.366, meaning 36.6% of the variance in the outcome was explained by the eighth-grade factors. The logistic regression models for the outcome of being on track at the end of the ninth grade were significant at all three grade levels using the established significance level of  $\alpha = .05$ ; therefore, the null hypothesis was rejected for research question three.

Analysis of the odds ratio statistic further illuminated the impact of core GPA on the outcome of being on track to graduate at the end of the ninth grade. For every unit (letter grade) increase in core GPA in sixth grade, there was a 304.7% increase in the odds of being on track in ninth grade ( $\text{Exp}(B) 4.047 - 1 = 3.047$ ). In the seventh grade, there was a 426.1% increase in the odds for being on track in ninth grade for every unit increase in core GPA ( $\text{Exp}(B) 5.261 - 1 = 4.261$ ). In the eighth grade, every one unit increase in core GPA increased the odds of being on track in ninth grade by 382.3% ( $\text{Exp}(B) 4.823 - 1 = 3.823$ ). While the odds ratio clearly improved as student GPA in the core subjects increased by one unit, the accuracy of the predictions on the outcome of ninth-grade on-track status was lower than the accuracy in forecasting graduated or dropout status.

The model for each of the three grade levels correctly predicted if students would be on track or not in the ninth grade with about 87% accuracy. The positive predictive value (specificity) of the sixth-grade model for on-track status in ninth grade follows:

$$1,104/(14 + 150 + 1,104) = 87.1\%.$$

In the seventh grade, the model predicted 1,114 (87.9%) cases correctly. Of the 154 (12.1%) cases incorrectly predicted, 14 were predicted to not be on track when they were, and 140 were forecasted to be on track when they were not. The positive predictive value (specificity) of the seventh-grade model for on-track status in ninth grade follows:

$$1,114/(14 + 140 + 1,114) = 87.9\%.$$

In the eighth grade, the model accurately predicted 1,106 (87.2%) cases. For all 162 (12.8%) subjects incorrectly forecasted, the model predicted they would be on track in the ninth grade when, in reality, they were not. The positive predictive value (specificity) of the eighth-grade model for on-track status in ninth grade follows:

$$1,106/(162 + 1,106) = 87.2\%.$$

The false-positive rate for all three grade levels was 12.9% (sixth and seventh 162/162 + 1,092, eighth 162/162 + 1,089). The false-negative rate for sixth and seventh grades was 1.3% and for eighth grade it was 1.5%. Sensitivity was 98.7% (1,092/14 + 1,092) for the sixth and seventh-grade models and 98.4% (1,089/17 + 1,089) for the eighth-grade model.

### **Findings Research Question 3A**

The individual background variables were tested to determine their moderating effect on the individual performance factors related to the outcome of on-track to graduate at the end of the ninth grade. This analysis answered research question 3A: Do these associations vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status)? The Wald chi-square and Nagelkerke R<sup>2</sup> statistics were analyzed to identify background factors that significantly moderated the effect of the individual performance factors for the outcome of on-track at the end of the ninth grade. The six background factors tested were gender, FRL status, White, Hispanic or Latino, disability status, and ELL status. The interaction

effect of each individual background variable was tested independently of the other background variables in each of the three grade-level models. Table 4.16 presents the unique predictive value of each background variable related to the outcome variable of on-track at the end of ninth grade.

**Table 4.16**

*Independent Background Variables Not in the Equation for On-Track at the End of Ninth Grade*

Sixth Grade	Sig.	Seventh Grade	Sig.	Eighth Grade	Sig.
Gender (1) <sup>a</sup>	.001	Gender(1)	.001	Gender(1)	.001
FRL(1) <sup>b</sup>	.000	FRL(1)	.002	FRL(1)	.000
White(1)	.000	White(1)	.000	White(1)	.000
Hisp or Lat(1) <sup>c</sup>	.000	Hisp or Lat(1)	.000	Hisp or Lat(1)	.000
Disab(1) <sup>d</sup>	.000	Disab(1)	.000	Disab(1)	.000
ELL(1) <sup>e</sup>	.000	ELL(1)	.000	ELL(1)	.000

*Note.* <sup>a</sup>Gender (Female = 1, Male = 0). <sup>b</sup>Free or Reduced-Price Lunch Status. <sup>c</sup>Hispanic or Latino. <sup>d</sup>Disability Status. <sup>e</sup>English Language Learner Status.

For all three grade levels, the interaction of disability status and core GPA was significant. The interaction statistic in the sixth grade was  $\chi^2(1, N = 1268) = 7.71, p = .006$ . In seventh grade, the result for disability status was  $\chi^2(1, N = 1268) = 5.66, p = .017$ . The interaction result for disability status in eighth grade was  $\chi^2(1, N = 1268) = 5.92, p = .015$ . The criterion for significance was set at  $\alpha = .05$ . Therefore, the null hypothesis was rejected for research question 3A.

Further analysis of disability status revealed that the Nagelkerke  $R^2$  statistic increased by about 1% for this background factor in each grade level. This finding was a relatively minor change to the  $R^2$  value. Additionally, the odds ratio was difficult to analyze, with so many variables impacting the directionality of the odds ratio statistic. The clustered bar chart shown in Figure 4.6 was constructed to visually demonstrate the seventh-grade data and the relationship between having a disability, core GPA, and the outcome of being on track at the end of the ninth

grade. Given that disability status in this longitudinal data set was stable between sixth, seventh, and eighth grades, Figure 4.6 was generated with seventh-grade data and used to interpret the sixth and eighth-grade results.

**Figure 4.6**

*Clustered Bar Chart: Interaction of Seventh-Grade Disability Status and Core GPA on the Outcome On-Track at the End of Ninth Grade*

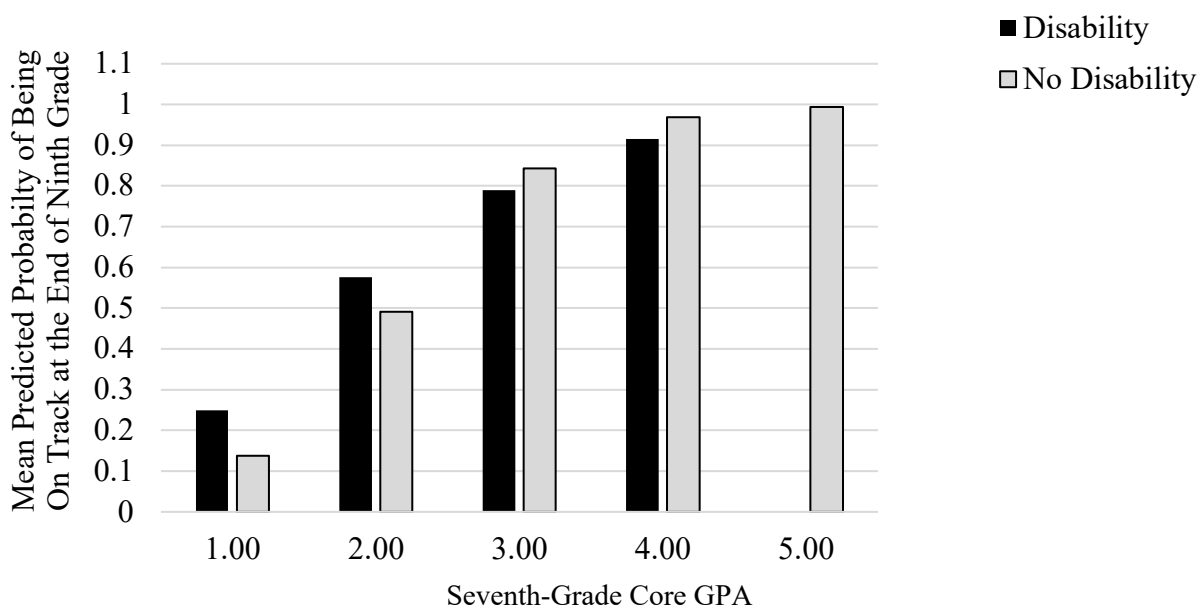


Figure 4.6 revealed it was more advantageous for students with a disability at the lower GPA levels (1.00 and 2.00) to increase their core GPA by one unit than it was for peers without a disability in relation to being on track at the end of ninth grade. For those with a higher GPA (3.00, 4.00, and 5.00), it was less advantageous for a student with a disability to increase their core GPA by one unit. The last pertinent observation was that 132 of the 1,268 (10.4%) students in this seventh-grade sample were identified to have a disability, but students with disabilities made up 35% of the seventh-grade students who earned a core GPA of 1.00. This percentage appears disproportionate compared to students without a disability; however, another consideration is that the total number of students in the core GPA category of 1.00 in the seventh grade was only 20 out of 1,268 (1.5%). One assumption for the binomial regression analysis was

a linear relationship between independent and dependent variables (Laerd Statistics, n.d.). The results from this interaction should be interpreted cautiously and not generalized to other settings because this assumption was not met.

Finally, a statistical model was constructed for each grade level using significant predictor variables associated with being on track at the end of the ninth grade status. According to the Nagelkerke  $R^2$  statistics for each grade-level model, the eighth-grade logistic regression model explained the highest percentage of the variance ( $R^2 = 0.366$ ) compared to the sixth ( $R^2 = 0.252$ ) and seventh grade ( $R^2 = 0.345$ ) models. The following equation represented the best fit model from the eighth grade that predicted the odds that a student would be on track to graduate at the end of the ninth grade with independent variable data for core GPA, number of disciplinary incidents, and chronic absence status:

$$\text{Eighth Grade: } \frac{P}{1-P} = .058 + 4.823 (\text{Core GPA}) + .935 (\text{Disciplinary incidents}) + 1.185 (\text{Chronic Absence Status}).$$

Overall, core GPA was a statistically significant predictor variable for being on track for graduation at the end of the ninth grade. The individual background factor of disability status significantly moderated core GPA at all grade levels, although these results should be regarded cautiously due to the non-linear relationship demonstrated. Chronic absence status and the number of disciplinary incidents experienced were significantly associated with being on track in ninth grade on their own merits. However, when the three predictor variables were combined in a binomial regression model, it was core GPA that remained significant when controlling for disciplinary incidents and chronic absence status. Chronic absence status and disciplinary incidents did not add value in determining who would be on track to graduate at the end of the ninth grade beyond the core GPA data.

## Conclusion

A number of logistic regression analysis models were computed to answer the research questions for this study. The results of those models were presented in this chapter. RVSD officials provided the data analyzed in this study, which included the following: number of course failures in ELA, number of course failures in math, number of course failures in core subjects, core subject GPA, number of days absent in a school year, number of disciplinary incidents, gender, FRL status, race and ethnicity, disability status, ELL status, high school end status, number of credits earned in ninth grade, number of course failures in ELA in ninth grade, and number of course failures in math in ninth grade.

Descriptive statistics were presented, and the course-performance variables were analyzed to determine which to use in the logistic regression models developed to answer the research questions. Nine logistic regression models were constructed to determine how the three individual performance variables of core GPA, chronic absence, and disciplinary incidents related to the three outcome variables of dropout status, graduated status, and on-track at the end of ninth grade. An additional 18 logistic regression models were tested at each grade level to determine the interaction effects of six background factors on three outcome variables. After the initial analysis of the course-performance variables, 69 logistic regression models were analyzed to answer the research questions for this study.

Analysis of the individual school performance factors revealed that core GPA was significant in all nine models related to three outcome variables. Additionally, the number of disciplinary incidents in sixth grade and chronic absence status in eighth grade proved significant in determining whether a student would graduate on time. An analysis of how individual background factors moderated the impact of the individual performance variables identified

disability status, White, Hispanic or Latino, and gender as significant moderators in select grade levels and in correlation with certain individual performance factors.

## CHAPTER V

### DISCUSSION AND CONCLUSION

As noted in the introduction of this project, graduating from high school has been noted as one of the most familiar coming of age rituals in the United States (Chappell et al., 2011). A multitude of studies linked this milestone to improved health, better future employment, post-secondary educational opportunities, and access to healthcare (Belfield & Levin, 2007; Carnevale et al., 2013; Lansford et al., 2016). Belfield and Levin (2007) also stated that high school graduation is viewed widely as a commonplace minimum competency requirement for higher education and post-secondary education. Yet, the Colorado graduation rate of 81% in 2019 (Colorado Department of Education [CDE], n.d.) lags behind the most recently reported national graduation rate of 85% in 2018 (NCES, n.d.). This study aimed to better understand student data in a suburban Colorado school district so that schools and districts can identify and offer additional support to students identified as at risk of dropping out of high school in Colorado.

A thorough review of the literature found that student performance in high school courses, school attendance, and disciplinary incidents predicted high school outcomes (Bowers et al., 2013; Bruce et al., 2011; Hillman, 2014). Furthermore, being on track for graduation when students reach the end of the ninth grade was found highly predictive of high school outcomes and believed to be a manifestation of student performance in elementary and middle school (Allensworth et al., 2014; Allensworth & Easton, 2005, 2007; Easton et al., 2017; Hernandez, 2011). Past studies were dominated by the high school outcome of dropping out, and settings for



those studies were predominantly urban school districts. The results of this study strengthened the literature for suburban high school settings with an analysis of longitudinal data that mapped middle school early warning indicators to the proximal outcome of performance in the ninth grade and the distal outcomes of graduating on time and dropping out of high school.

Three research questions were developed, each with a related sub-question. The research questions required determining the accuracy of predictor variables in the sixth, seventh, and eighth grades to identify which students were off track for graduating and clarify when those early warning signs first appeared. The research questions, sub-questions, and hypotheses were:

- Q1 How do the individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades predict that a student will drop out of high school?
  - Q1A Do these associations vary according to student background variables (i.e., gender, free or reduced-price lunch [FRL] status, race and ethnicity, disability status, English language learner [ELL] status)?
- Q2 How do the individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades predict that a student will graduate on time from high school?
  - Q2A Do these associations vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status)?
- Q3 How do the individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades predict that a student will be on track to graduate at the end of the ninth grade (six credits earned and no failing grades in math or English)?
  - Q3A Do these associations vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status)?
- H1 The individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades have no predictive relationship to dropping out of high school.
  - H1A These associations do not vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status).

- H2 The individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades have no predictive relationship to graduating on time.
- H2A These associations do not vary according to student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status).
- H3 The individual performance variables of course performance, school absences, and the number of disciplinary incidents in the sixth, seventh, and eighth grades have no predictive relationship to being on track to graduate at the end of the ninth grade (six credits earned and no failing grades in math or English).
- H3A These associations do not vary according to upon student background variables (i.e., gender, FRL status, race and ethnicity, disability status, ELL status).

To answer these questions and respond to the related hypotheses, this study provided an extensive analysis of a cohort of students, following them from sixth grade through their high school outcomes. It also expanded Hillman's (2014) study of a suburban Colorado school district with the added outcome variable of on-track to graduate at the end of the ninth grade and the additional predictor variables of ELL status and FRL status.

### **Discussion of the Findings**

The three main research questions for this study required analysis of three independent predictor variables: core grade point average (GPA), number of disciplinary incidents experienced, and chronic absence status. This triad of variables was tested using binomial regression analyses in the sixth, seventh, and eighth grades for each outcome variable of dropout status (RQ1), graduated status (RQ2), and on time at the end of the ninth grade status (RQ3). Research questions one, two, and three each included a sub-question about the moderation effect of student background factors on that triad of independent predictor variables.

This study was a secondary analysis of data previously collected by a school district for their own purposes. Its analysis of secondary data required an explanation of how the multiple variables affect each other (Creswell, 2015). As Agresti and Finlay (2009) explained, variables

were determined to interact if the relationship between one predictor variable and outcome depended on another predictor variable, also referred to as an interaction effect. The interaction between each of the independent background variables of gender, FRL status, race and ethnicity, disability status, ELL status, and the three individual performance variables was analyzed to answer the three research sub-questions.

## **Discussion of Dropout Status**

### **Results**

Research question one asked how core GPA, chronic absences, and disciplinary incidents in the sixth, seventh, and eighth grades predicted high school dropout rates. Three logistic regression models were tested, one for each of the grade levels. The logistic regression models all yielded significant results related to dropout status. When the unique predictive value of core GPA, number of disciplinary incidents, and chronic absence status were analyzed within the models, core GPA was the single significant variable. While the accuracy of these predictions was technically 98.1% for each grade level, the false-positive rate was 1.9%. A deeper examination of the false-positive rate revealed that 24 out of 1,268 subjects in the sample actually dropped out of high school.

The logistic regression models (sixth grade, seventh grade, and eighth grade) for dropout status all incorrectly predicted that the 24 subjects who dropped out would graduate on time. In a related study, Neild and Balfanz (2006) found that about 20% of students who dropped out did so late in high school when they were relatively close to obtaining a high school diploma. The authors explained that it was more challenging to predict who would drop out in the 11<sup>th</sup> or 12<sup>th</sup> grades because the reasons for dropping out were related to unpredictable life events such as pregnancy, economic hardship, homelessness, or mental health issues (Neild & Balfanz, 2006). To reduce the false-positive rate, the cut value of the logistic regression model could be adjusted

from .500 to a higher or lower threshold (Laerd Statistics, n.d.). A cut value of .500 was standard for logistic regression, meaning that if a subject has an estimated probability of 50% or greater of being in the “yes” category, then the model codes them as “yes” for the outcome variable (Laerd Statistics, n.d.). Increases in core GPA were strongly associated with decreased odds of dropping out, and chronic absence status and the number of disciplinary incidents students experienced added no significant information to help predict who would drop out when all three variables were combined into one model.

The background factors were analyzed to answer the sub-question for research question one. Females benefited more than males when the number of disciplinary incidents they experienced was reduced. Additionally, students who identified as White in this study with a core GPA in the lowest two categories of “F” or “D” were more positively impacted than their non-White peers when they increased their core GPA by one letter grade. The non-White group of students included Hispanic and Latino, Asian, Black or African American, two or more races, American Indian or Alaskan Native, and Native Hawaiian or Other Pacific Islander. When students identified as Hispanic or Latino were isolated and compared with students in all other race and ethnicity categories, they benefited less from a one-unit improvement in their core GPA.

White (63.6%) and Hispanic or Latino (30%) students represented 93.6% of the subjects in this sample. Because a small sample size increases sampling bias (Agresti & Finlay, 2009), only the categories White and Hispanic or Latino had large enough counts in the samples to be included as independent background variables. The remaining race and ethnicity categories with small sample sizes were included in the overall analysis as non-White and non-Hispanic or Latino subjects. Students who identified as White with a lower core GPA (1.00, 2.00) were impacted more positively by every unit increase in core GPA compared to non-White students

with a lower core GPA. The opposite was true for students identified as Hispanic or Latino, who had a weaker association between increased core GPA in seventh grade and reduced odds of dropping out than their peers who were not Hispanic or Latino. These results aligned with McFarland et al. (2018), who found that students identified as American Indian or Alaska Native, Black, Hispanic, or Pacific Islander were more likely to drop out of high school as compared to students identified as White or Asian, and these differences were statistically significant.

The interaction effect of FRL on the predictor variables and dropout status was notable. When the moderation effect of FRL was tested in the sixth grade, the Nagelkerke  $R^2$  revealed an increase of 0.06, explaining an additional 6% of the variance in dropout status. While FRL did not result in a significant chi-square statistic, the impact of FRL on the independent predictor variables in sixth grade aligned with past research. Low socioeconomic status significantly increased the odds of dropping out in several studies (Cratty, 2012; Christle et al., 2007; Hernandez, 2011). In this study, when controlling for all other variables, FRL status did not add more information to determine more accurately which students would drop out of high school.

This study revealed that students benefited in varied ways from an increase in core GPA where dropout status was concerned, even though an increase in core GPA was positively associated with reducing the likelihood of dropping out. This study also revealed that the models became progressively stronger in predicting dropout status from sixth through eighth grade. According to the Nagelkerke  $R^2$  and the Wald chi-square statistics, the most robust model was in eighth grade, where 20% of the variance in dropout status was explained, followed very closely by seventh grade and then sixth grade.

## **Discussion of Graduated Status Results**

Research question two analyzed how core GPA, chronic absences, and disciplinary incidents in the sixth, seventh, and eighth grades predicted graduating from high school on time. Logistic regression models for each grade level were constructed, and core GPA was a significant predictor for future graduation at all three grade levels. In sixth grade, the number of disciplinary incidents was also significant. In the eighth grade, chronic absence status was also significant. The triad of core GPA, disciplinary incidents, and chronic absence status correctly predicted about 96% of student outcomes, and the false-positive rate was a little over 3% at all three grade levels.

The first of two background variables that significantly moderated the predictor variables was the race and ethnicity category White. Students identified as White benefited more than their non-White peers when their absences changed from chronic (missing 17 or more days) to not chronic (missing less than 17 days) in the sixth and eighth grades. Chronic absence was not significant with regard to graduated status in the initial regression analysis before adding the moderation effect of this background factor. Since 63.6% of the sample was identified as White and 62.1% of sixth-grade students were chronically absent, there was no disproportionality between White and non-White regarding sixth-grade chronic absence status. The race or ethnicity of a student may logically explain this result, so further analyses of these subgroups may reveal other factors unique to the White or non-White groups, such as FRL status or the attitudes and dispositions of staff toward non-White students. This study illuminated a difference between White and non-White students that was not expected in the data. Any intervention plan for students off track for graduation should attempt to understand this outcome in more detail.

The other background variable that significantly moderated the predictor variables was disability status in sixth and eighth grades. The odds of graduating on time were much more significant for students with a disability than their peers without a disability in sixth and eighth grades. While the odds ratio proved better for students with a disability where core GPA was concerned, the Nagelkerke  $R^2$  was only about 2% for students with a disability, meaning an additional 2% of the variance in graduation status was explained when considering disability status.

In summary, the eighth-grade model was the strongest when considering how much of the variance in graduation outcomes could be explained by the three grade-level models, followed by the seventh-grade model and then the sixth-grade model. This study revealed two background factors that changed the relationship between a predictor variable and the outcome of graduating on time: disability status and the race and ethnicity category White. The background factor of identifying as White revealed differences related to the effect chronic absence status had on graduating on time between White and non-White students. Delving into individual student case studies may benefit school leaders as they attempt to devise effective intervention plans and construct meaningful support systems for students. The disability status results were surprising. Perhaps this was evidence that individual education plans for students with identified disabilities effectively support students on their quest to graduate. This result aligns with what McGee (2011) found—in some studies, students with disabilities outperformed their peers with similar cognitive abilities on the outcome of graduating. McGee (2011) further offered that one possible explanation for this was the successful interventions students with disabilities received as part of their IEPs. There may be a benefit to River Vista School District (RVSD) school leaders probing this finding since students with disabilities represented a wide

range of academic and social performance, ranging from students who receive minimal resources for a reading issue to those with significant cognitive impairments that impact a major life function.

### **Discussion of On-track Results**

The final research question asked how core GPA, chronic absences, and disciplinary incidents in the sixth, seventh, and eighth grades predicted being on track for graduation at the end of the ninth grade. Logistic regression models were tested at each grade level, and core GPA was significant at all three grade levels. The three grade-level models accurately predicted about 87% to 88% of the students who were on track in ninth grade. Neither chronic absence status nor the number of disciplinary incidents experienced added unique significant value to the models.

The only background variable that significantly moderated the individual performance variables at all three grade levels was disability status. The scatter plot in Figure 4.2 assisted with understanding the coefficients and results of these logistic regression models. Figure 4.2 revealed that when students with disabilities achieved a core GPA in the “F” (0.00–0.99) or “D” (1.00–1.99) range, they benefited from an increase in core GPA of one unit (letter grade) more than their peers who did not have a disability. For students with a core GPA of “C” or higher, there was almost no difference in the benefits students with and without a disability experienced when they increased their core GPA by one letter grade. The generalizability of this interaction effect is limited since there was evidence that the relationship between core GPA and disability status may be non-linear for the outcome variable of being on track in ninth grade. Further examination of how students with disabilities compare with students without disabilities on core GPA performance is recommended since the overall number of students in the core GPA category of 1.00 in the seventh grade (20 out of 1,268) was small in this study.



Overall, core GPA was the only significant predictor variable among core GPA, chronic absence status, and discipline referrals when all three were entered into a logistic regression equation. Students greatly benefited from increasing their core GPA by one unit, or one letter grade, in each middle school year. An improvement of one unit in core GPA increased the odds of being on track in the ninth grade by 304.7% in sixth grade, 426.1% in seventh grade, and 382.3% in eighth grade. In sixth grade, 25% of the variance was explained. In seventh grade, that jumped to 34.5%, and the eighth-grade model explained 36.6% of the variance in being on track. The variance in the outcome of being on track in ninth grade was explained more comprehensively from sixth through eighth grades.

### **Implications**

This study makes several contributions to the field of education. The study scope, size, and structure add value to the base of current research. The results can be used by school leaders in the participating school district and those in school districts with similar demographics.

### **Field of Research**

First, the results of this study contribute to the body of research in this field with respect to monitoring early warning indicators to identify students who may be falling off the track to graduate from high school on time. The findings demonstrated that in a suburban setting, middle school student performance in core courses was significantly associated with whether they would graduate on time, drop out, or be on track for graduation at the end of the ninth grade. This study confirmed that course failures, chronic absences, and the number of disciplinary incidents students experienced each correlated significantly to all three outcome variables.

Previous studies also connected middle school course failures to dropping out or not graduating on time (BERC, 2011; Kurlaender et al., 2008; Neild & Balfanz, 2006). Results from

this study mirrored previous research initiatives that found poor attendance to be predictive of dropping out, not graduating on time, and a lower likelihood of being on track in ninth grade (Allensworth et al., 2014; Allensworth & Easton, 2007; BERC, 2011; Hillman, 2014; Kieffer & Marinell, 2012; Kurlaender et al., 2008; Neild & Balfanz, 2006). Past studies revealed that students who experience more discipline in the form of suspensions or removal from class were less likely to graduate and more likely to drop out (Christle et al., 2007; Goldschmidt & Wang, 1999; Hillman, 2014). However, when the three predictor variables of core GPA, chronic absences, and the number of disciplinary incidents were analyzed together, core GPA was the consistent predictor variable that had significance at all three grade levels and for all three outcome variables. In addition to core GPA at all three grade levels, disciplinary incidents in sixth grade and chronic absence status in eighth grade were also significant when tested with the triad of independent predictor variables.

This study also contributed information to research regarding how student background factors moderate other variables in a suburban setting. In most of the logistic regression models, individual background factors did not add significant information that assisted with predicting the outcome variables. In the sixth grade, there were differences in how gender moderated the independent variable of chronic absences related to dropout status. Males were more adversely impacted by each additional discipline incident they experienced than females. There were occasions where the background variables of White, Hispanic or Latino, and disability status moderated specific predictor variables as well. While students associated with these background variables showed a difference in odds ratios, the only instance where the results of the original model shifted was in sixth grade, when gender moderated disciplinary incidents related to dropout status.

Without background factors in the model, core GPA was the only significant predictor variable. When gender was added to the model, the number of disciplinary incidents also became significant. In all other cases, the predictor variables in the original bundle that were significant remained so, and the ones that were not did not become significant. This outcome should not detract from the fact that differences were noted in the odds of students reaching the outcome variables, and school leaders can examine their systems to assess how to mitigate these differences.

### **School Leaders**

Past researchers emphasized the importance of accurately identifying students not on track to graduate as early as possible in order to provide them with timely support tailored to their needs (Bowers et al., 2013; Bruce et al., 2011). This study provides suburban school districts similar to RVSD with information about the early warning indicators (EWI) that signal when middle school students are or are not on track. Core GPA, chronic absences, and disciplinary incidents play a role in signaling which students need additional support and intervention. While core GPA may be the main predictor for graduation, the closer examination of particular student experiences may reveal information that further guides school leaders in deciding the type of intervention and support needed. This study provides school leaders with observational data they can use to tailor a comprehensive early warning system (EWS) (Therriault, O’Cummings, Heppen, Yerhot, & Scala, 2013; Therriault, O’Cummings, Heppen, Yerhot, Scala, & Perry, 2013). Related to this is the need for school leaders to examine the role of the administrators and school counselors in an EWS. As a matter of policy, case management of students who are off track for graduation most aligns with the role of school counselors, with school administrators ensuring this is fulfilled effectively. District administrators should consider

revising job descriptions for school counselors to include these case management responsibilities for EWS at the middle school level and beyond.

Based on the results from this study, the researcher recommends that school leaders create a system for monitoring core GPA, chronic absence status, and how staff members administer discipline, specifically removing students from class. While the eighth-grade data most accurately predicted the three outcomes in this study, the researcher recommends monitoring these data points as early as the sixth grade for practical reasons. As Bruce et al. (2011) ascertained, students establish habits and build their knowledge and skills base in the elementary and middle school grades. The importance of approaching EWS as a district is further reinforced by the results of this study related to student background factors. While core GPA was the strongest EWI to identify students who were off track for graduation, the background factors of FRL, disability status, and race and ethnicity were significant when considered in isolation. When the aggregate of all students across RVSD was examined, the background factors did not add predictive value in identifying students for the outcome variables. However, at the school level, this may not be the case. District leaders can ensure that an EWS is implemented equitably across all schools, and resources associated with identification, support, and interventions are also distributed equitably. This study reinforced findings from previous studies that indicators emerge as early as sixth grade that set students apart from those who are on track to graduate, allowing educators to respond and change that trajectory.

Performance in the ninth grade was defined as a critical and highly predictive of high school end status (Allensworth et al., 2014; Allensworth & Easton, 2005, 2007; Easton et al., 2017; Hernandez, 2011), and this study proved that to be true in the chosen suburban setting. While there are students who perform well in middle school and then do not perform well in

ninth grade, intervention and support can be provided for students who exhibit signs that they will likely not be successful in the ninth grade. That intervention and support can be directly related to student data but should also be considered for staff and teachers.

The final recommendation is that professional learning occurs in a systemic and ongoing manner for all staff who interact with students. The issues related to student underperformance are complex, and when school leaders seek to solve them by intervening with students, they miss the critical lever of the quality and skill level of the teacher. The deep body of research illustrating teacher effectiveness and its impact on student success in school was not included in this study, yet is relevant to EWS, where interventions and other approaches are selected for students. Hattie (2003) suggested that 50% of the variance of school success can be explained by student-specific factors such as skills and knowledge that provide a basis for students to build upon new learning. Hattie also pointed out that teacher knowledge, actions, and values explain an additional 30% of the variance in student success. Hattie further found differences within the teacher ranks and suggested that expert teachers have more impact on student outcomes than experienced and novice teachers (2003). While this study focused on the accurate identification of students who may be off track for high school graduation, school leaders should not mistake that to mean that interventions and support be limited to those directly designed for students.

To further illustrate the importance of school leaders using information from this study thoughtfully, consider chronic absence status. Chronic absences are highly problematic. Students who were absent more than 10% of all school days in a year will have missed out on the continuity of instruction and critical content knowledge necessary for future academic success. Findings from this and previous studies suggest chronic absences be monitored as an early warning indicator. School leaders should explore the factors that lead to chronic absences for

individual students and provide support and intervention to improve school attendance. The investigation of why students struggle to attend school should encompass factors beyond an individual student's control. Chronic absences among students may be caused by poor relationships with teachers, a lack of cultural competence on the part of the staff, poorly supervised interactions between students that may be harmful, the lack of strong instructional strategies that engage students and make learning relevant and engaging, or staff who believe certain students cannot achieve at high levels. These examples may contribute to a student being chronically absent, and all are staff issues that school leaders can address. However, none can be corrected by interventions with students.

A similar analysis applies to core GPA and the number of disciplinary incidents students experience. There are likely to be interventions that apply to conditions the student can control and improve and interventions that will improve the broader educational environment.

### **Limitations**

Though this study contributed to the body of research on early warning indicators and the identification of students who fall off track for graduating on time while they are in middle school, it also had some limitations. Students can be associated with several background factors, and combinations of those factors might change the odds of dropping out, graduating on time, or being on track at the end of the ninth grade. However, the design of this study was limited to analyzing each background factor individually. Further analysis of the presence of multiple background factors on the outcome variables could provide additional helpful information for school leaders.

Another limitation was that this study was designed as longitudinal, examining a cohort of students as they progressed from sixth grade through to their high school end status. However,

the longitudinal design of this study also created a limitation—students who moved in and out of the district were not included. To demonstrate the impact of choosing a longitudinal design, RVSD had a graduation rate of 86.3% in 2019. The sample for this study included students who remained in RVSD from sixth grade through high school, and their graduation rate was 96.1% in 2019. Student stability within the district for this sample may have skewed the results positively. Out of the 1,268 students in the sample, 49 (3.9%) did not graduate on time, and of those, 24 (1.9%) dropped out. The small percentage of students who did not graduate on time and who dropped out may have limited the ability of the models to more precisely predict high school end status.

A lack of nuance in examining disability status and ELL status was also a limitation. For example, there was no discernment between disability categories or different levels of language proficiency. Disability status encompassed a wide range of students, from those who receive only speech and language services to others with significant cognitive needs. For ELL status, all students who qualified for English as a second language services were included as one group. For example, this study did not examine if the results would be different for a limited English proficient student versus a non-English proficient student.

The last limitation is connected to the predictor variable of chronic absence status. This variable was dichotomous. If the number of school absences was treated as a continuous variable, the relationship between this variable and the three outcomes might have differed. It could be that ten absences were as detrimental as 17 or more. Thus, a more comprehensive exploration of absences as a continuous variable may further inform an EWS plan.

### **Future Research**

Future research could build upon this study and further examine student performance within the background categories of disability and ELL status. Another way to build upon this study would be to analyze the background factors more deeply to determine if combinations of these factors significantly change the results. For example, it would be interesting to uncover whether there would be a significant result if gender and FRL status were examined together or if race and gender were considered simultaneously. Finally, qualitative research involving observations of staff and interviews with administrators, staff, and students may lead to insights into how different students experience a suburban school system like RVSD. Qualitative research could further inform the design of student interventions as part of an EWS and inform professional development that supports staff, teachers, and administrators who make educational decisions that significantly impact students.

### **Conclusion**

In this study, an analysis of logistic regression models provided information about which early warning indicators educators should monitor, clarifying when those indicators become relevant in predicting high school outcomes. A discussion of the findings organized by the three outcome variables was included in this chapter. The findings revealed that educators can use performance measures in middle school to identify which students may not be on track to graduate on time. Furthermore, these findings revealed clear indicators that signaled students were not on track to engage in ninth grade successfully.

Ninth grade was defined as a critical and proven school year that sets students on a course toward success or failure in high school (Allensworth et al., 2014; Allensworth & Easton, 2005 & 2007; Easton et al., 2017; Hernandez, 2011), and results from this study found that to be true



in the chosen suburban setting. Implications of this research were presented for the field of early warning systems and, more practically, for school leaders seeking ways to systemically and accurately identify students who need additional support or intervention to better inform the timeliness and selection of an intervention that sets students on a path to graduate on time. The limitations of this study were reported, and recommendations for future research were also explored.

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**APPENDIX**  
**INSTITUTIONAL REVIEW BOARD APPROVAL**



Date: 11/16/2020  
 Principal Investigator: Dina Perfetti-Deany  
 Committee Action: **IRB EXEMPT DETERMINATION – New Protocol**  
 Action Date: 11/16/2020  
 Protocol Number: [2010013734](#)  
 Protocol Title: Identifying Early Warning Indicators for Improved High School Outcomes for Students  
 Expiration Date:

The University of Northern Colorado Institutional Review Board has reviewed your protocol and determined your project to be exempt under 45 CFR 46.104(d)(704) for research involving

Category 4 (2018): SECONDARY RESEARCH USING IDENTIFIABLE DATA OR SPECIMENS. Secondary research for which consent is not required: Secondary research uses of identifiable private information or identifiable biospecimens, if at least one of the following criteria is met: (i) The identifiable private information or identifiable biospecimens are publicly available; (ii) Information, which may include information about biospecimens, is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained directly or through identifiers linked to the subjects, the investigator does not contact the subjects, and the investigator will not re-identify subjects; (iii) The research involves only information collection and analysis involving the investigator's use of identifiable health information when that use is regulated under 45 CFR parts 160 and 164, subparts A and E, for the purposes of "health care operations" or "research" as those terms are defined at 45 CFR 164.501 or for "public health activities and purposes" as described under 45 CFR 164.512(b); or (iv) The research is conducted by, or on behalf of, a Federal department or agency using government-generated or government-collected information obtained for nonresearch activities, if the research generates identifiable private information that is or will be maintained on information technology that is subject to and in compliance with section 208(b) of the E-Government Act of 2002, 44 U.S.C. 3501 note, if all of the identifiable private information collected, used, or generated as part of the activity will be maintained in systems of records subject to the Privacy Act of 1974, 5 U.S.C. 552a, and, if applicable, the information used in the research was collected subject to the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 et seq.



You may begin conducting your research as outlined in your protocol. Your study does not require further review from the IRB, unless changes need to be made to your approved protocol.

**As the Principal Investigator (PI), you are still responsible for contacting the UNC IRB office if and when:**

- You wish to deviate from the described protocol and would like to formally submit a modification request. Prior IRB approval must be obtained before any changes can be implemented (except to eliminate an immediate hazard to research participants).
- You make changes to the research personnel working on this study (add or drop research staff on this protocol).
- At the end of the study or before you leave The University of Northern Colorado and are no longer a student or employee, to request your protocol be closed. \*You cannot continue to reference UNC on any documents (including the informed consent form) or conduct the study under the auspices of UNC if you are no longer a student/employee of this university.
- You have received or have been made aware of any complaints, problems, or adverse events that are related or possibly related to participation in the research.

If you have any questions, please contact the Research Compliance Manager, Nicole Morse, at 970-351-1910 or via e-mail at [nicole.morse@unco.edu](mailto:nicole.morse@unco.edu). Additional information concerning the requirements for the protection of human subjects may be found at the Office of Human Research Protection website - <http://hhs.gov/ohrp/> and <https://www.unco.edu/research/research-integrity-and-compliance/institutional-review-board/>.

Sincerely,

A handwritten signature in black ink that reads "Nicole Morse".

Nicole Morse  
Research Compliance Manager

University of Northern Colorado: FWA00000784