DEVELOPING AND TESTING AN EARLY WARNING SYSTEM TO IMPROVE HIGH SCHOOL GRADUATION

by

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A DISSERTATION

Presented to the Department of Educational Methodology, Policy, and Leadership
and the Graduate School of the University of Oregon
in partial fulfillment of the requirements
for the degree of
Doctor of Education

June 2016

DISSERTATION APPROVAL PAGE

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Title: Developing and Testing an Early Warning System to Improve High School Graduation

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DISSERTATION ABSTRACT

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June 2016

Title: Developing and Testing an Early Warning System to Improve High School Graduation

The nation has placed a spotlight on improving graduation rates for all students. The current study analyzed retrospective, longitudinal student data from the fifth largest school district in Oregon to create an Early Warning Indicator System (EWS) to identify students on track to graduate and those who are not. This study creates an EWS system using the student demographics and the ABC's of (a) attendance, (b) behavior, and (c) coursework to identify students who are on track and those who are not.

I employed logistic regression model to build a prediction model using middle school data (N = 2,041) that examined predictors established in sixth through eighth grade with high school graduation. The dependent variable, four-year graduation was coded as graduate or non-graduate. The independent variables were (a) gender, (b) race, (c) ELL status, (d) SPED Status (e) attendance rate, (f) ODR's, and (g) number of F's in English Language Arts and Mathematics.

Attendance rate was the strongest predictor of high school graduation. Overall the model predicted graduates with 89.7% accuracy and non-graduates with 33.6% accuracy with the total model predicting 69.5% of graduates and non-graduates.

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ACKNOWLEDGMENTS

Over the past three years I have received support and encouragement from many individuals. I wish to express my sincere appreciation to my advisor Michael Bullis for his unwavering support. Without his advice and persistent help this dissertation would not have been possible. I would like to thank my dissertation committee of Christopher Murray, Keith Hollenbeck, and Mark Van Ryzin for their insightful comments and advice for my research. In addition, special thanks to Jo Smith for her support throughout the entire program. She was the glue that kept our cohort together. I would also like to thank JC for all the time and nourishment through the writing process. Last but not least I would like to thank my friends and family for giving me support during this incredible journey.

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CHAPTER I

INTRODUCTION

The purpose of this dissertation study was to (a) test local indicators of an Early Warning Indicator System (EWS) to identify students who are on track to graduate and those who are not and (b) investigate the effectiveness of the system to identify middle-school students at-risk for not graduating high school. The study took place in the Bend-La Pine School district where the four-year graduation rate in 2013 was 76.6% (DePaoli et al., 2015) and the dropout rate for the district was roughly 2% (Oregon Report Card, 2013). For this study, I focused on the four-year graduation rate and what contributes to students graduating in that time frame or not.

Many studies to date highlight the importance of reducing school dropout, which is emphasized in my literature synthesis. Although dropout is not the inverse of graduation, most of the literature I reviewed focuses on decreasing the number school dropouts to improve graduation rates. High school dropout rates tend to be a misleading because dropouts are reported for all grades across a district, resulting in diluted percentage across a larger range of grade levels (DePaoli et al., 2015). Graduation rates are a more consistent measure for a cohort study with a more uniform definition, as well as a larger statistic for analysis.

This study builds off of what is known about the predictor variables used to identify potential dropouts to create a local EWS to improve gradation rates in the local district. The same predictor variables that have identified dropouts in past research are used to identify students who successfully graduated in four years. Reducing the amount

of students who fail to graduate high school in fours years is essential to improving the overall graduate rate in the district, state, and nation.

This chapter discusses the high school dropout epidemic and the social and economic implications of low graduation rates, thus forming the case for the study. Following that discussion, I describe an EWS that I studied in the Bend-La Pine School district with a focus on middle school students at-risk to not graduate high school. Finally, I present a (a) theoretical framework and (b) summary of the current literature in this subject area. Before progressing to those two sections, I first define key terms that are prevalent in this subject area, but have different meanings and implications for the educational field at large and for this dissertation project in particular.

Definitions of Key Terms

The Oregon Report Card defines cohort outcomes in three ways: (a) adjusted cohort graduation rate, (b) completion rate, (c) five-year graduation rate, and (d) dropout rate. Oregon Cohort Graduation Rate Policy and Technical Manual used by all Oregon School districts in 2012-2013 and 2013-2014 for state reporting, defines cohorts of students to report outcomes for high school graduation and completion or the lack thereof. Cohorts are created using first time ninth graders with an expected graduation in four years. To be considered in the four-year adjusted cohort graduation rate (ACGR), students must have the outcome of a regular diploma that meets district and state requirements in four years. Cohorts are adjusted for students that move out of or in to the cohort during the four years. The ACGR was first implemented in the 2010-2011 school year (DePaoli et al., 2015).

The completion rate was defined as, "students receiving a regular, modified,

extended, or adult high school diploma or completing a GED" (Oregon Department of Education, 2013). Students had five years to complete one of the listed diploma options to be considered as part of the completion rate.

If a student did not graduate within four years with a regular diploma, they were not automatically considered a dropout or non-completer in Oregon. A student could continue in high school for a fifth year and finish with a regular diploma in five years and they were included in the five-year graduation rate.

The dropout rate was defined as the student who drops out during the given school year and does not re-enroll. Students who were enrolled in a cohort at some point during the four years and did not have an exit code or an outcome defined above were considered a dropout/non-continuing student. School records were tracked, so if a student's school records were never moved to a new school, they were considered a dropout. Students who had other high school exit codes from transfer to death were not counted as a dropout. Table 2 presents high school outcome data from the Oregon Report Card for the Bend-La Pine School district and state in 2012-2013 and 2013-2014.

Table 1
High School Outcomes for 2013 and 2014

	Bend-La Pine Performance		Oregon Performance	
	2012-13	2013-14	2012-13	2013-14
Graduation Rate	72.2%	78.6%	68.4%	68.7%
Completion Rate	81.3%	84.1%	80.5%	81.5%
Dropout Rate	2%	2.6%	3.4%	4%

(Oregon Report Card, 2013 & 2014)

This study used extant data gathered regularly by the district for students in 6th grade to 8th grade to construct the model. Specifically, I included first time 6th grade students from 2006-2007 and 2007-2008 (projected graduation of 2012-2013 and 2013-

2014), and analyzed data for those individuals who either graduated high school successfully and those who did not graduate high school in four years.

The Problem

The nation has placed a spotlight on improving graduation rates for all students, including those who have been traditionally underserved or who present distinct learning challenges (DePaoli, Fox, Ingram, Maushard, Bridgeland, & Balfanz, 2015). The increased attention from social, political, and governmental agencies, as well as from the K-20 educational sector, has created considerable pressure on educators to develop systems to identify and intervene with students who are likely not to graduate high school (Bruce, Bridgeland, Fox & Balfanz, 2011). It follows that by identifying potential dropouts earlier, interventions can be fashioned for those at-risk students to forestall them from dropping out and foster their successful school graduation.

National high school graduation rates are rising, yet Oregon presents staggering low graduation rates, ranking 49th of 50 states in 2013 (DePaoli et al., 2015). Oregon was 1 of 10 states in the US that gained less than 1% in adjusted cohort graduation rates (ACGR[1]) from 68% in 2011 to 68.7% in 2013 (DePaoli et al., 2015). The lack of improvement regarding graduation has put Oregon as the last state to have an ACGR in the 60% range (DePaoli et al., 2015). According to the U.S. Department of Education, the 2013 ACGR in Oregon was 68.7%, in contrast to the national ACGR of 80%. For Oregon to meet President Obama's goal to increase the K-12 graduation rate to 90% by 2020

[1] ACGR (Adjusted Cohort Graduation Rate) is calculated using the number of students who graduate in four years with a regular diploma divided by the number of students who started high school four years earlier (adjusting for transfers in and out) (U.S. Department of Education, 2008). ACGR was first implemented in 2010-2011 school year.

(Balfanz, Bridgeland, Bruce & Fox, 2012) an identification and intervention system to improve graduation rates is mandatory.

Students with disabilities, English Language Learners (ELL), and economically disadvantaged students experience even worse graduation rates in Oregon. Of the 13.6% of Oregon's students identified with a disability under the Individuals with Disabilities Education Act (IDEA), only 37.2% graduated with a regular diploma (DePaoli et al., 2015). The graduation rate for Oregon's ELL students in 2013 was reported as 49.1%, which is 19.6% lower than the in ACGR of all students in the state. Oregon's economically disadvantaged student ACGR was 60.4% compared to the national ACGR for economically disadvantaged students of 73.3% (DePaoli et al., 2015). Table 1 presents gradation data from 2013 for the Bend-La Pine School District, Oregon, and the nation for (a) all students (b) students with disabilities, and (c) economically disadvantaged.

Table 2
Comparison of School District, State, and National ACGR for 2013

Measure	District	Oregon	National
2013 Graduation Rate (all students)	76.6%	68.7%	80.0%
2013 Graduation Rate (Student with Disabilities)	52.8%	37.2%	61.9%
2013 Graduation Rate (Economically Disadvantaged)	70.3%	60.4%	73.3%

(DePaoli et al., 2015)

From Table 1 it is evident that to improve overall graduation rates we must give considerable attention to subgroups of the student population. Public schools currently are made up of majority of low-income students; in 2013, 51% of students in the United States were considered economically disadvantaged (DePaoli et al., 2015). Oregon's low-income Adjusted Cohort Graduation Rate (ACGR) in 2013 was 60.4%; compared to non-low income ACGR was 78.2%, which presents a gap of 17.8% between the groups. ELL,

special education, and economically disadvantaged students struggle most with on-time graduation rate, as evidenced by the staggering low ACGR (DePaoli et al., 2015).

Students who do not earn a high school diploma face considerable economic and social challenges (Sum, Khatiwada, & McLaughlin, 2009). High school dropouts are eight times more likely to be incarcerated and three times more likely to be unemployed than people with a high school diploma, differences which carry a profound economic impact on the individual and the community (Bridgeland et al., 2006; Shannon & Bylsma, 2006). Moreover, dropouts between the ages of 16 to 24 are *63 times more likely* than high school graduates to enter the criminal justice system (Sum et al. 2009).

In a related vein, educational achievement is one of the strongest predictors of personal health. The less schooling completed by a person the higher their risk for early death, risky behaviors, obesity, or having low physical activity (Freudenberg, 2007). The higher a person's educational attainment, the more access they have to safer neighborhoods, healthier foods, better health care, and insurance (Freudenberg, 2007). High school dropout is an epidemic that affects not only the individual, but also the greater community and society.

From the literature discussed above, it should be clear that improving graduation rates is important for our society in many ways (i.e., dropouts increase costs with incarceration, health care and social services and generate lower taxes due to poorer work trajectories, Jerald, 2006). Given Oregon's position as one of the states with the poorest graduation rate, U.S. Senator Wyden identified this problem as the greatest issue facing the state's economic development and future (Hammond, 2015). For example, high school graduates earn more money than dropouts; specifically, high school graduates earn

$130,000 more and college graduates earn $1 million more than high school dropouts over a lifetime (Balfanz, Bridgeland, Bruce, & Fox, 2012).

There is broad agreement that educational systems should graduate students who are proficient in core academic subjects, able to work well with others, practice healthy behaviors, and act responsibly and respectfully (Association for Supervision and Curriculum Development, 2007; Greenberg et al., 2003). This goal is described below:

> Young adolescents make critical and complex life choices that will affect their academic and social options for the remainder of their lives...for nearly a quarter of these students, the seeds of withdrawal from school and the life-long consequences of underemployment, limited income, and involvement with the justice system are planted in these years. (National Association of State Boards of Education, 2008, p. 4)

There are some subgroups of students who present higher level of dropout than the average. The subgroups that present high dropout rates are: (a) English language learners (ELL), (b) students with a disability, and (c) economically disadvantaged. Demographic characteristics such as disability, race, and gender have been correlated with dropping out of school as well (Rumberger, 1987, 2004). Roughly 12% of the variation in graduation rates is explained by gender, race, and economic status (Allensworth & Easton, 2007). Generally, school absenteeism, poor behavior (defined by teacher assigned grades), and course failure in English and mathematicsematics are associated with dropout status as well (Kennelly & Monrad, 2007).

Logically, it should be possible to use variables such as those identified in the previous paragraph to establish an early warning indicator system (EWS). That is, schools can use data that are gathered routinely, and in some instances data, which will require unique collection, to identify indicators associated with students who are potential to not graduate on time (Kennelly & Monrad, 2007; Mac Iver & Mac Iver, 2009). By

identifying students at-risk for not graduating high school early in their middle or secondary school years the hope is that interventions can be fashioned to support students to achieve in academic programs and graduate from high school successfully (Kennelly & Monrad, 2007; Mac Iver & Mac Iver, 2009).

There are many cases of educators using EWS to predict and intervene with 9th grade students, but a number of educators believe that at that point in a student's school trajectory it is too late to get students back on track to complete their education (West, 2013). In line with this position, middle schools have started to implement systems to identify students not on track to graduate before students transition to high school in the hope of catching students who potentially could not graduate high school (Heppen & Therriault, 2008). The middle grades play an especially critical role in placing all students on the path to high school graduation and improving graduation rates (Civic Enterprise, 2012). Middle school students who are in disengaged or in the process of disengaging from school are absent more often, display behavioral problems, or have failing grades in classes (Finn, 1989). By focusing on middles grades, we can find students who are in the process of disengaging or have disengaged and intervene in order to get them on the path of graduation.

It follows that it is critical for school districts to identify and intervene with students at the middle school level to have the best chance to improve high school graduation rates. The purpose of this study was to identify relationships and patterns that best predict school graduation in the Bend-La Pine School District in Central Oregon. The study built upon the work that has been done across the nation to better pinpoint what works for students in the local area.

Theoretical Model

Students do not graduate high school for many reasons and the process of navigating to graduation is complex. Understanding factors that contribute to high school performance is key to addressing the critical issue. Social science researchers have studied a range of factors that lead to school dropout (Rumberger, 2011). A number of theories have been developed to explain the process of dropping out (e.g. Finn, 1989; Coleman 1988; Ogbu, 1992; Newmann, Wehlage, & Lamborn, 1992). These theories were used to construct 'The Conceptual Framework of High School Performance' created by Rumberger and Lim (2008). Rumberger and Lim based their framework on a review of 203 peer-reviewed studies. This extensive review of research has led to a framework that is widely used and is cited in more than 240 scholarly articles.

I base the theoretical model I developed for this dissertation study on Rumberger and Lim (2008) framework. In the next pages I present the framework, review its factors, and provide context on how I plan to use it in this study.

The *Conceptual Model of High School Performance* focuses on two different factors that lead to student drop out: (a) individual factors and (b) institutional factors. Individual factors are based on the individual while institutional factors are based on contextual factors of students' families, schools and communities (Rumberger & Lim, 2008). This model suggests that high school graduation is conditional on both persistence and achievement (Rumberger & Lim, 2008). The reciprocal relationships presented in this model show that factors can change over time and stability of the student is the cause and consequence of school engagement. Individual factors can be grouped into four broad constructs (a) background, (b) attitudes, (c) behaviors, and (d) performance. One or

more indicators or variables represent each of the four constructs. These constructs are displayed in a linier model, but should be considered reciprocal, as each influences another. For example, attitudes will shape behaviors and as time goes on those behaviors will shape new attitude.

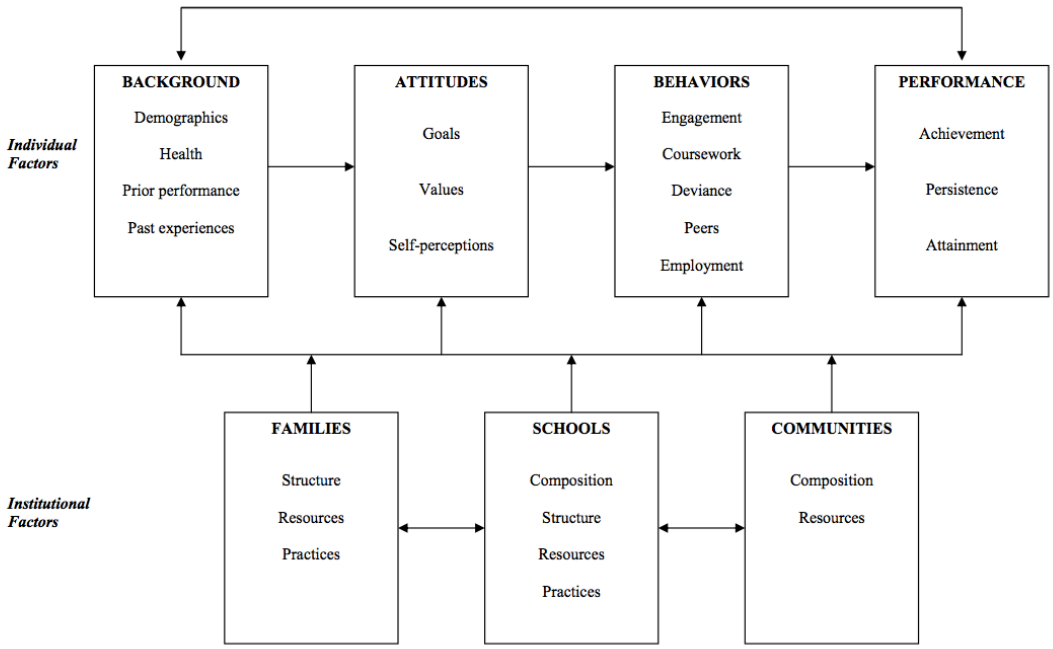

Figure 1. The conceptual model of student performance in high school
Source: Rumberger & Lim, (2008).

Background. The first construct in the model is *background*, which includes demographics, health, prior performance, and past experiences. This construct includes past performance in school and experience in participating in school programs like preschool, after school activities, and summer school. Health includes both mental and physical can be a cause of drop out. Demographics such as sex, race, ethnicity immigration status, English language proficiency and disability status determine high school graduation (Rumberger and Lim, 2008).

Attitudes. The second construct in the model is *attitudes*, which represents a wide

range of psychological factors. The attitudes construct represents a wide range of factors like (a) expectations, (b) goals, (c) values and (d) self-perception (e.g., perceived competence, autonomy, and sense of belonging) (Rumberger & Lim, 2008). They found students have to value school and believe they are capable of achieving success to be successful in school. Students can arrive at school with a set of attitudes and attitudes can be set based on experiences at school. Attitudes can connect to behaviors and student performance in school.

Behaviors. The third construct in the model is *behaviors*. Behaviors associated with educational performance include (a) engagement, (b) course taking, (c) deviance, (d) peer association, and (e) employment. Student engagement is complex as it is reflective of students' attitudes, behaviors, values, and beliefs towards school. School attendance and student discipline are the most common measures of student engagement (Rumberger, 2001). Other behaviors identified in the research literature and associated with dropping out of school include (a) misbehavior, (b) drug and alcohol use, (c) childbearing, (d) peer associations, and (e) employment.

Performance. The forth construct in the model is *educational performance*. The three interrelated dimensions of educational performance are (a) academic achievement, exhibited by test scores and grades; (b) educational persistence, indicated by the students remaining in the same school, transfer or remain in enrolled in school at all; and (c) educational attainment which is reflected by progressing in school by advancing grades and earning credits.

The literature for EWS identifies the ABC's- (a) attendance, (b) behavior, and (c) coursework as the factors that contribute to student success in school. I used these factors

to create model for the current study. The model accounts for student background characteristics and builds off of the individual factors of (a) attendance, (b) behavior, and (c) coursework to find the predictability to school graduation. Figure 2 presents the ABC's of Early Warning Indicators Model. Attendance is an individual student characteristic that illustrates student persistence and engagement. Behavior, also an individual student characteristic, is associated with school engagement and deviance. Coursework represents educational performance through the dimension of academic achievement. The positive overlap of the three constructs represents the increased likelihood for a student to graduate. The more negative the constructs, the more likely a student will disengage from school and not graduate high school. Determining the strongest set of predictors is key to providing intervention to students (Rumberger, 2004).

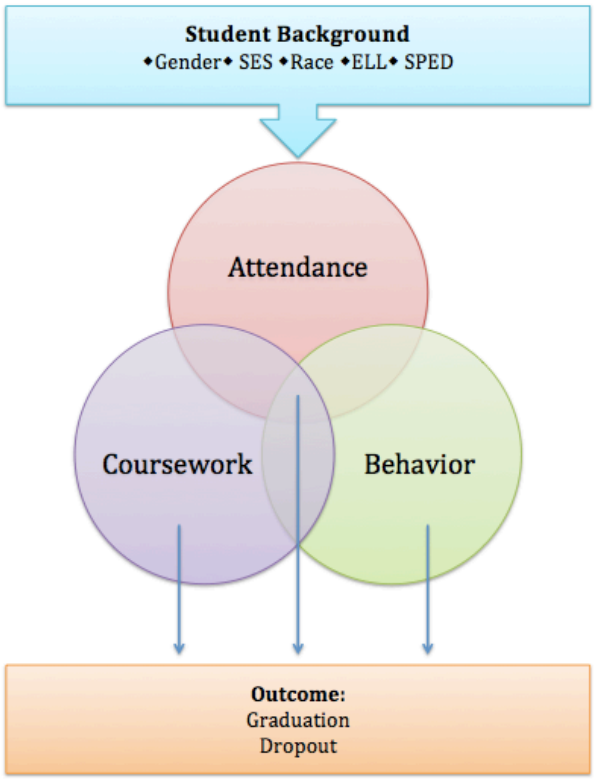

Figure 2. ABC's of Early Warning Indicators Model

Not graduating from high school cannot be pinpointed to one specific factor, rather is caused by an array of factors. Student factors including attitudes, behaviors, and performance are linked to disengagement with eventual school dropout. Moreover, evidence highlights that different factors may be relevant to different students and local predictors should be identified as part of predicting indicators that increase the likelihood of leaving school unsuccessfully (Balfanz et al., 2007, Heppen & Therriault, 2008; Johnson, & Semmelroth, 2010).

This ABC's of Early Warning Indicators theoretical model led me to focus my literature review on malleable factors of (a) attendance, (b) behavior, and (c) coursework along with demographic variables to high school graduation. Specifically, I wanted to examine these factors because middle and high school personnel collect such data routinely already for state reporting. I focus my search to the relationship each factor had with successful graduation or the lack thereof.

Literature Synthesis

The purpose of this section is to summarize and synthesize the research literature to (a) identify research themes as a context for my dissertation study to identify the strongest predictors of high school dropout. Consistent with the model I have adopted for the study, I included the following themes in my review (a) attendance, (b) behavior, (c) coursework, and (d) background demographics.

Review Process. I employed an electronic search process to identify research literature pertaining to early warning indicators of high school dropout focusing specifically upon (a) attendance, (b) behavior, (c) coursework, and (d) background as

each relates to dropout. I used the University of Oregon library main search page, Google Scholar, APA *PsycNet,* ERIC, and Proquest. I focused on articles published no more than the last 15 years (2000-2015) to focus on the most current research and include recent demographic changes evident across the US. I narrowed my selection criterion to peer-reviewed journals to have the most recent research for the topic of dropout indicators. Publications used were the Journal of Adolescence, Educational Psychology, The Journal of Educational Research, and Journal of Education for Students Placed At Risk.

My initial pool of citations included 44 articles, of which I retained 10 articles for further review. The articles I chose to retain in the literature pool all related to school dropout identified through early warning indicators of attendance, behavior and coursework. I chose not to keep articles that focused on other risky behaviors such as drugs use or teen pregnancy because of my focus on middle school and indicators routinely monitored by schools. I read the abstracts and focused on research completed in the North America using EWI to prevent dropouts. Since my study was completed in the Oregon, I wanted to focus on U.S. because teaching strategies and dropout definitions in other countries can vary. I concluded with 5 more articles that met the search criteria I set initially and that emerged (i.e., years & location). By employing those inclusion and exclusion rules described above, I ended with 15 references for the review. Next, I describe the type of research, followed by a description of the samples, settings, measures and the results. I highlight what research says about (a) attendance, (b) behavior, and (c) coursework as the strongest predictors for high school dropout.

Type of Research. All 15 articles used longitudinal data that tracked students over time ranging from 2-12 years. A total of 11 of the 15 studies used extant data from

district databases or national data sets, 3 studies utilized mixed methods of surveys and extant data, and 1 used only surveys.

There were four studies that utilized a survey to measure school engagement. Archambault et al. (2009) utilize a teacher distributed student survey to measure (a) behavior engagement (b) affective engagement and (c) cognitive engagement of seventh to ninth graders. Jordan et al. (2012) used NLSY97 and NLSY79 geocoded using the USDA Beale Code System to determine urban, suburban, and rural context to allow for more detailed analysis. Lee et al. (2011) used a school climate survey administered to ninth-grade students as part of the Virginia High School Safety Study (VHSSS). The survey was used in combination with school suspension and dropout rates to determine the student attitudes and perceptions related to school climate. Soland (2013) used a subsample of the National Education Longitudinal Study (NELS) along with school records to determine GPA. The NELS teacher survey asked teachers to predict whether individual students would graduate from high school or enroll in college.

There were three studies that employed a mixed-methods approach by utilizing a combination of extant data and interviews to capture information about student dropout risk factors. Suh and Suh (2007) combined data collected by National Longitudinal Survey of Youth (NLSY97) database from the U.S. Department of Labor along with interviews of students and parents. In the first round of data collection (1997) both the student and one parent were personally interviewed for an hour. From 1997 to 2001, each student was re-interviewed annually. The NLSY97 considered 180 variables that may be contributing factors to student dropout and used multiple regressions to narrow down to 16 of the most statistically significant variables. The 16 variables included six

quantitative and 10 qualitative predictor variables. The qualitative variables were coded to into two categories. The study used the outcome variable dropout to represent either dropout or completion of high school. Two predictor models were created (Model 1 and Model 2) to test predictors of dropout using the 16 variables. Model 1 included three risk factors, (a) academic risk, (b) low socioeconomic status, and (c) behavioral problems. In Model 2 all 16 variables are used and risk factors are added as a predictor to the model. Regression analyses were used find the strongest predictors of high school dropout.

Subjects. Appendix A summarizes the demographics of the subjects studied in the reviewed literature. The sample sizes of the studies range from 193 to 169,953. All of the studies were published in the last 15 years. Extant data were used in 11 of the studies and projected gradation dates range from 1979-2011. The sample of subjects in each study had varying demographics to represent different ethnic groups, gender, and status of ELL and students with a disability. Socioeconomic status was reported in 4 studies and ranged from 20%-70%. The demographic data vary in each study and range in diversity. Studies ranged from 3%- 50% Hispanic, 15%-58% African American and 15%-91% White, 1% or less Asian/Pacific Islander and 0.3%-2.3% Native American.

A total of 4 of the 15 studies included subjects from the elementary school level. These students were studied from fourth grade to expected graduation (8 years). Seven of the studies use middle school subjects and 4 used high school subjects. The majority of studies focused on the secondary level with a wide range of demographics and sample sizes. My study replicates some of the research that has been done with middle school subjects with non-diverse sample.

Settings. The settings differed across the studies. In the articles reviewed (a)

urban, (b) suburban, and (c) rural areas as well as the region of the United States were explored. Eleven studies were conducted in urban settings; the other studies reviewed were conducted in suburban (n = 2) or a mix of rural and urban (n = 2) settings. The regional location of the 15 studies included Northeast (n=6), Southeast (n=2), Midwest (n=1), Northwest (n=2), and four were conducted in multiple U.S. regions.

Most of the studies on EWS were conducted in large urban areas like Philadelphia, New York City, and Baltimore. Two studies were from the Pacific Northwest (a) Johnson and Semmelroth (2010) and (b) McIntosh, Flannery, Sugai, Braun, and Cochrane (2008). In the study by Johnson and Semmelroth (2010) they utilized two high schools in a suburban area in the Pacific Northwest. McIntosh et al. (2008) used a small, growing school district in the Pacific Northwest with a district enrollment K-12 of 5,542. The studies to date have mainly been done in large urban cities in the Northeast; therefore more research is needed in the Pacific Northwest.

Measures. Appendix B lists and describes the measures used in each study. Out of the 15 studies, 14 use either graduation or dropout statistics. In those studies 12 used the outcome variable of dropout, two use graduation, and two use both graduation and dropout. Graduation was defined in eight studies as earning a regular high school diploma and define dropout as a student that have academic records that ended before earning a high school diploma. Additional criteria of a special education certificate or a GED to categorize students as graduates of high school are used in five studies. The independent variables varied across the studies, including attendance, behavior, coursework grades, standardized tests, demographic, overage and status data.

The data for five studies used national data sets. Two studies use National Longitudinal Survey of Youth (NLSY) survey from two data sets (NLSY79 and NLSY97). The NLSY97 is a nationally reprehensive sample of 9,000 students 12-16 years old at the conception of the survey and NLSY79 consists of 12,686 14-22 years of age in 1979. Students were interviewed annually and it is designed to document the transition from school to adulthood. The National Educational Longitudinal Study (NELS) is a nationally representative eighth graders, parents, and teachers to compare teacher predictions with student outcomes for dropping out of school.

Three studies investigated dropout through engagement-based predictors. The construct of student engagement as measured by feelings of attachment and belongingness to social institutions. Archambault et al. (2009) used a teacher distributed, Likert scale self-report student questionnaire to gauge school engagement levels. The questionnaire addressed behavioral, affective and cognitive engagement. The engagement survey results were then correlated to data on attendance, behavior, grades, and status variables- maternal education and course retention. Behavioral engagement measures attendance and compliance with school rules. Affective engagement measured enjoyment and interest in school. Cognitive engagement assessed willingness to learn, specifically in mathematics and foreign languages (Archambault et al., 2009).

Barry and Reschly (2012) utilized third grade data for the subjects using ACT Early Project data (Advancing the Competencies of Teachers for Early Behavioral Interventions of At-Risk Children; Baker, Kamphaus, & Horne, 1999) including the Behavior Assessment System for Children (BASC; Reynolds & Kamphaus, 1992), and the Iowa Tests of Basic Skills (ITBS) in reading, language arts and mathematics. The

teacher rating scale on the BASC contained Likert-type items to rate students on internalizing and externalizing behaviors. School records provided data on variables like demographics, attendance, and school completion. Barry and Reschly (2012) reported that the instruments used are psychometrically sound. The independent variables to predict high school drop out varied in use across the studies reviewed. Four studies used attendance, behavior, and grades to test indicators for high school dropout. Attendance and grades were used in two studies. Suspension or behavior data were utilized in eight studies, with 3 of those 8 studies only using suspensions as a measurement of behavior. The measures most widely used in the research reviewed were data sets of (a) attendance, (b) behavior, and (c) coursework collected by district databases. Replicating this work led to creating an EWS for my school district.

Results. Of the 15 studies, 3 presented results that described (a) attendance, (b) behavior, and (c) coursework as the strongest predictors for high school dropout (Balfanz et al., 2007, Gleason & Dynarski, 2002, Mac Iver & Messel, 2013). Students who have trouble in one or more of these warning indicators are more likely to dropout (Suh & Suh, 2007). The pivotal years to detect students at-risk to dropout of school are sixth and ninth grade (McIntosh et al., 2008; Mac Iver & Messel, 2013). The transition from the elementary to middle school setting and middle school to high school setting increases the chance of disengagement from school. Next, I review each indicator.

Student Background. Risk factors for high school dropouts include ethnicity, race, and gender. Jordan et al. (2012) used data from NLSY 97 and NLSY 79 to conclude Black males are twice as likely to dropout than white males even when family characteristics are controlled; the factors are (a) gender, (b) race, (c) family assets, (d)

presents of biological parents, (e) maternal attributes, and (f) peers characteristics. Students in small metro areas are more likely to graduate than large metro areas. The researchers also found that females are more likely to graduate than males in all geographic areas (Jordan et al., 2012).

Lee et al. (2011) reported demographic variables made a much stronger impact to the White versus the Black dropout rate. Free or reduced meal prices were the only variable that made a statistically significant contribution to the Black dropout rate.

English language learners or students with disabilities have a reduced chance of graduating on time with a regular diploma. Balfanz et al., (2007) found the predictive power of these variables (English language learners or students with disabilities) did not meet the required threshold of 75% to be a highly predictive indicator.

Attendance. Of the 15 studies, 4 concluded that high absenteeism was the strongest predictor of school dropout (Gleason & Dynarski, 2002, Johnson & Semmelroth, 2010, Mac Iver & Messel, 2013, Schoeneberger, 2012). The factors Gleason and Dynarski (2002) found to be the strongest risk factors for middle school students were high absenteeism and overage by two years, 15% of students with high absenteeism and 16% of students with overage dropped out. That is, student attendance forecasted dropout better than student willingness and effort to learn the basic curriculum and how much pleasure was associated with school-related issues (Archambault, Janosz, Fallu, & Pagani, 2009). Schoeneberger (2012) reported the Chronic Truant group (truancy across all grade levels) exhibited the second highest dropout rate at 21% with Early Truants (truancy only in early elementary) had the highest dropout rate of 25%.

Attendance was defined as a warning indicator when a student was attending

school less than 80% and it identified 75% or more of students who do not graduate (Balfanz, et al., 2007, Henry et al., 2012, Johnson & Semmelroth, 2010, Mac Iver & Messel, 2013). Although studies also found that at 90% attendance identified students at risk of dropping out of school (Balfanz, et al., 2007, Schoeneberger, 2012). Johnson & Semmelroth (2010) found that attendance had the highest accuracy of all the single predictors. Kieffer et al., (2014) recommends that we should look at longitudinal attendance data to better identify students who declined over time as indicators of school disengagement versus a single point in time. These data suggests the importance schools should put on early intervention of chronic absenteeism to increase probability of graduation (Mac Iver & Messel, 2013). Balfanz et al., (2007) used a logistic regression in their study and found that students who were chronically absent were 68% less likely to graduate than students not chronically absent.

Behavior. In the six studies that list school-based behavior as an indicator of school dropout, behavior was measured in four ways (a) suspensions, (b) behavior grades, (c) behavior Assessment System for Children, Teacher Rating Scale (BASC TRS-C), (d) disciplinary problems reported on surveys, and (e) office discipline referrals (ODR). Balfanz et al. (2007) used both suspensions and behavior grades given by teachers. They found the more out-of-school suspensions, the greater the chance of a student not completing school. The teacher behavior grades in 6th grade predicted half of the non-graduates in the district. Teacher given behavior grades are a significant warning flag for school dropout and students were 56% less likely to graduate than others (Balfanz et al., 2007). McIntosh et al., (2008) described the relationship between poor behavior and the impact on academics as the presence of problem behaviors closely

interferes with academic learning. School wide suspension rates are positively correlated to school wide dropout rates ($\beta = .42, p < .01$) when demographic variables were controlled (Lee, Cornell, Gregory, & Fan, 2011) Lee et al. (2011) reported high suspension rates were consistently associated with high school dropout rates. Schools that suspended nearly 22% of their students each year had a dropout rate (3.52) that was 56% greater than the dropout rate (2.26) for schools that only suspended 9% of their students.

Coursework. Academic achievement was represented in the studies either as coursework or tests and the variables used are (a) teacher assigned grades, (b) noncumulative GPA, (c) Iowa Tests of Basic Skills (ITBS), (d) standardized test scores, and (e) course failures. Bowers (2010) found the combination of grades and noncumulative GPA was strong predictor of eventual dropout. Students who failed English were 42% less like to graduate and students who failed mathematics were 54% less likely to graduate than students passing mathematics and English (Balfanz et al., 2007). Test scores in reading or mathematics are not as strong predictors as grades (Balfanz et al., 2007). Only students in the 10th percentile or less on end of 5th grade tests in reading or mathematics had predictive power of not graduating. Johnson and Semmelroth (2010) also found GPA and course F's to be the strongest predictors at the high school level. Given that GPA and course F's are related to each other, it should be expected that the yield similar results. GPA had a sensitivity level of 86% with a specificity of 81%. The number of course F's had the highest sensitivity level at 87% with a specificity of 69%.

Indicators Combined. Students with one or more of the warning indicators have a 29% graduation rate in the study (Balfanz et al., 2007). Specifically, the researchers

found that course failures and low attendance in 8th grade are strong predictors, almost determiners of school dropout (Balfanz et al., 2007).

McIntosh et al. (2008) found a statistical significance between problem behavior and academics, whereas students with behavior problems were more likely to have both behavior and academic problems. The combination of warning indicators presents an increased risk of drop out for students.

Conclusion

This literature review provides evidence for the use of EWS to warn off school dropouts and improve graduation rates. The three indicators with the strongest impact on school graduation were (a) attendance, (b) behavior, (c) coursework (Balfanz et al., 2007, Barry and Reschly, 2012, Mac Iver & Messel, 2013, Schoeneberger, 2012, Suh & Suh, 2007). Two clear paths for dropping out of school emerged from the literature review (a) academic struggle and failure and (b) behavior reactions to the school environment (Balfanz et al., 2007). The combination of multiple warning indicators increases the chance for dropout (Balfanz et al., 2007). Creating a predictor model that takes in account demographic data in combination with the three indicators of (a) attendance, (b) behavior, (c) coursework will help us routinely identify students in middle school that are at risk to not graduate on time from high school.

Rationale for Study

McIntosh, et al. (2008) found that waiting until high school to identify individual students at risk to not graduate from high school may be too late successfully intervene. They propose earlier identification and intervention to get students back on track to graduation. Research suggests that middle schools can identify and intervene with

students not on track to graduate (Christenson & Thurlow, 2004).

Improving graduation rates in Oregon is imperative. I can build on the current research from across the United States to identify and test predictors' specific to our region to improve graduation rates. There have not been any studies conducted on EWS in Oregon, yet Oregon has dismal graduation rates. Studies to this point have been in urban settings with large samples sizes on the east coast. Therefore more research is needed in the Pacific Northwest to set local indicators for an EWS to improve school graduation. Districts and schools need to develop early interventions that match the predictive measures to improve high school graduation. Chapter 2 will describe the methodology used for this study. Specifically, in this study, I addressed the following research questions:

Research Question 1: What are the demographics of graduates and non-graduates?

Research Question 2: What combination of variables best predicts high school graduation in four years?

Chapter II

METHODS

The purpose of this study was to address the research questions presented in Chapter 1. Prior research suggests an Early Warning Indicator System (EWS) should use local school data to develop systems to identify and intervene with students who are likely to not graduate (Bruce, Bridgeland, Fox & Balfanz, 2011). In line with the study's purpose and the above recommendations, I analyzed retrospective, longitudinal data from the Bend-La Pine school district to establish an EWS at the middle school level to predict successful high school graduation in four years. I gathered data for two cohorts on (a) attendance, (b) behavior, (c) coursework and (d) demographic data, including gender and race as well as status variables of ELL and SPED.

Participants and Setting

I utilized two cohorts of middle school students from the Bend-La Pine School district in Central Oregon. Cohort 1 was comprised of approximately 1,029 students who were first time 6th graders in 2006-2007 with an expected graduation in 2012-2013. Cohort 2 was comprised of approximately 1,056 students who were first time 6th graders in 2007-2008 with a projected graduation in 2013-2014. I used two cohorts, which allowed me to examine if the predictors are the same across cohorts.

Bend had a population of 76,693 at the time of the 2010 US Census. According to the United States Census Bureau the median household income in Bend in 2009-2013 was $53,027 compared to $50,209 for the state of Oregon. Roughly 12.8% of Bend's population lived below the poverty level in 2009-2013 compared to 16.2% in Oregon.

The Bend-La Pine School district is based in Bend and spans 1,600 square miles in Central Oregon. The district encompasses 28 schools, with five middle and five high schools. The district serves approximately 17,000 students kindergarten through twelfth grade. Table 3 presents the demographics from the entire district for the two graduating classes in the study, showing they are similar in demographics between years.

Table 3:
Bend-La Pine District Demographics in 2013 and 2014

	2012-2013	**2013-2014**
District Enrollment	16,381	16,658
District Graduation Rate	72.2%	78.6%
District Dropout Rate	2.0%	2.6%
English Language Learners	6%	7%
Economically Disadvantaged	45%	44%
Students with disabilities	14%	13%
Languages spoken	23	20

Student Characteristics. The cohorts were comprised of first time 6th grade students in fall 2006 and fall 2007. Specifically, I identified first-time 6th graders by selecting students who completed 5th grade in the previous year. Table 4 presents data for both cohorts broken down by school with details of (a) sample size, (b) percent of students with disabilities (SPED), (c) gender, and (d) race. From this table the schools varied in enrollment size and the makeup of the student demographics. Particularly, middle school 3 had the most ELL students, while middle school 2 had the highest percentage of SPED students. School 4 had the least diversity, but the highest SES.

Table 4
Demographic Data for Cohorts in Study

	n	SPED	SES	Male	Female	Hispanic	White	Black	Asian/ Pacific Islander	American Indian/ Alaskan Native	Unknown race
	n=2085	*n*=350	*n*= 822	*n*= 1023	*n*= 1062	*n*= 181	*n*= 1821	*n*= 18	*n*= 35	*n*= 21	*n*= 9
Middle School 1											
Cohort 1	*266*	11%	20%	50%	50%	5%	91%	<1%	<1%	<1%	<1%
Cohort 2	*279*	12%	25%	53%	47%	10%	89%	<1%	<1%	0	0
Middle School 2											
Cohort 1	*240*	24%	40%	46%	54%	11%	84%	<1%	<1%	<1%	<1%
Cohort 2	*267*	20%	38%	45%	55%	8%	87%	<1%	<1%	<1%	<1%
Middle School 3											
Cohort 1	*181*	18%	56%	52%	48%	18%	75%	<1%	<1%	<1%	0
Cohort 2	*190*	25%	66%	51%	49%	14%	81%	<1%	<1%	<1%	0
Middle School 4											
Cohort 1	*134*	15%	61%	53%	47%	5%	91%	0	<1%	<1%	<1%
Cohort 2	*96*	20%	67%	44%	56%	<1%	94%	0	<1%	<1%	<1%
Middle School 5											
Cohort 1	*208*	13%	26%	44%	56%	5%	91%	<1%	<1%	<1%	<1%
Cohort 2	*224*	13%	32%	51%	49%	5%	91%	<1%	<1%	<1%	<1%

Extant Data Source

The Bend-La Pine School District provided official school data used in this study; specifically I worked with the Instructional Technology Architect to secure these data. Using my review of the literature to guide my decisions, I requested the datasets to include: (a) gender, (b) race, (c) ELL status, (d) SPED status, (e) student status (graduate, non-graduate), (f) attendance percentages in the 6th, 7th, 8th grades, (g) behavior as indicated by the number of office discipline referrals, (h) behavior measured by the number of days suspended, and (i) number of course failures in English and Mathematics in the 6th, 7th, 8th grades. Student personal identification data were removed and replaced by a random identification number to ensure confidentiality. The Instructional Technology Architect ensured data cleaning was done and verified the accuracy of the data, checking values to make sure data for the specified variables were not out-of-range or incorrect. Those data were provided to me in an Excel spreadsheet. Table 5 presents the way in which the variables were coded.

Table 5
Code Definitions

Field Name	Code	Meaning
COHORT CODES		
	0	The student was in grade 6 in the 2006-2007 school year
	1	The student was in grade 6 in the 2007-2008 school year
GENDER CODES		
	0	Male
	1	Female
RACE CODES		
	0	White
	1	Non-White
SPED CODES		
	0	Student does not have a SPED classification
	1	Student has a SPED classification
ELL CODES		
	0	Student does not have an ELL classification
	1	Student has an ELL classification
HS_GRAD CODES		
	0	Student did not graduate High School within four years of entry
	1	Student graduated High School within four years of entry

Variables. My theoretical model, presented in Chapter 1, accounts for student background characteristics and builds off of Rumberger and Lim's (2008) individual factors. I used (a) attendance, (b) behavior, (c) coursework, and (d) demographics to create an Early Warning Indicators System (EWS) to identify students who graduated and those did not to use in the Bend-La Pine school district.

Attendance. I calculated yearly attendance percentages for each student in 6th, 7th, and 8th grade. The percentages were calculated as the total days present divided by the total days enrolled for each school year. Teachers recorded attendance by class each day and attendance personnel monitored it for accuracy both at the school and district level. Teachers are accountable to enter attendance for each period of the day, the school then tracks to make sure all attendance is recorded and then codes the absences for excused or unexcused. The district monitors the data to make sure it is complete for each student. For yearly attendance rates the minimum and maximum across all grade were computed and the correlation was r = .75. The minimum value was retained (Mean = 0.90, SD = 0.07, range = 0.38 – 1.00).

Behavior. Yearly data files were used to determine student behavior. Office discipline referrals (ODR) for major and minor offenses and number of days suspended was analyzed for each student during 6th, 7th, and 8th grade. Office discipline referrals were entered by trained staff at each school and monitored for accuracy at the district and state level. The number of discipline referrals was counted on a cumulative continuous scale as the total number of events during 6th, 7th, and 8th grade. For example, if a student had three discipline referrals during 6th grade, zero in 7th grade, and one in 8th grade the score for this variable would be 4. The number of days suspended was counted on a cumulative continuous scale as the total number of events during

6th, 7th, and 8th grade. For example, if a student had two days of suspension during 6th grade, one in 7th grade, and three in 8th grade the score for this variable would be 5.

Coursework. English and Mathematics course grades were measured as the total number of failing grades in 6th, 7th, and 8th grade reported on official report cards for all students in the cohorts. Each student had three trimesters each year with one mathematics class and one language arts class, for a total of 9 times a grade is recorded. The number of F's was recorded as a cumulative continuous variable; e.g., if a student received four Fs on his or her transcript, the score for this variable would be 4. Teachers were responsible to input these grades at the classroom level into the Synergy system.

Demographics. I reported general student demographic data including (a) ELL status, (b) special education status, (c) gender, and (d) race. Students who were in ELL for any part of their time in middle school were coded as being part of the ELL program even if they were exited out. Students who had been identified for an IEP at any point during middle school were coded special education for the study.

Outcome Variable. Graduation data were collected for all students. The district data were coded *0* for non-graduates and *1* for graduates. Students who did not receive a regular diploma in four years were coded as a non-graduate. I narrowed my definition of graduation to students who complete with a regular diploma is 4 years. Students are defined as a non-graduate if they receive (a) extended or special education diplomas, (b) adult high school diplomas, (c) GED or (c) continued for a fifth year. Cohort 1 was comprised of students who entered high school in 2009-10; these are the students with an expected graduation by the end of the 2012-13 school year. Cohort 2 was comprised of students who entered high school in 2010-11; these are the students with an expected graduation by the end of the 2013-14 school year.

Missing Data

Of the 2,041 students in the total sample, 1,810 (89%) had complete data sets. There were 144 (7%) students missing 38% of the predictor variables and 4% of students in the study were missing 69% of the predictor variables. Demographic variables and the graduation outcome were complete for all cases. Incomplete data sets were a result of missing (a) attendance, (b) behavior, or (c) coursework data.

Those students with complete data were compared to those with incomplete data. There was a significant relationship between missing data and graduation status; 87% of students with incomplete data failed to graduate compared to 30% with complete data failed to graduate. Since missing data were related to the outcome, a single imputed dataset was generated using sequential regression multiple imputation (SRMI). This procedure was generated with the IVEWare program (Raghunathan, Solenberger, & Hoewyk, 2002). IVEWare creates multiple regression imputations sequentially. Using the observed covariates the conditional density of multiple variables with missing values was factored into an individual conditional density function for each variable. The density is modeled through a regression procedure appropriate for each variable. Imputations for missing values were drawn from a posterior predictive distribution.

Analysis

Quantitative analyses were used to determine the statistically significant differences between the high school graduates and non-graduates in each cohort and total sample of students using a variety of predictor variables at the middle school level. The SAS software (SAS, 2011) was used to run the analysis.

Research Question 1. *What are the demographics of graduates and non-graduates?* Demographic characteristics such as disability, race, socioeconomic status, and gender have been associated with dropping out of school (Rumberger, 1987, 2004). I calculated and reported descriptive analysis for both high school graduates and non-graduates. I reported means, frequency counts, and percentages for both high school graduates and non-graduates for (a) gender, (b) race, (c) ELL status, and (d) special education status.

Research Question 2. *What combination of variables best predicts high school graduation in four years?* For these cohorts of the Bend-La Pine school district I used a logistic regression to build a predictive model to identify a relationship between predictor variables and the outcome variable of graduation. The goal for employing this type of statistical analysis was to find the best fitting model to describe the relationship between the predictor and outcome variables. As well as explain relationships between predictor variables and the outcome variable when other variables are taken into account. The logistic regression analysis will help determine what are the most important predictor variables for successfully graduating high school. Logistic regression is regularly used in social science research because the analyses of odds ratios are generally easy to understand (Hosmer, et al., 2013). The logistic regression model for this study, was written as:

$$\text{Logit (p)} = \text{Log} \quad \frac{\text{(probability of graduating high school)}}{\text{(probability of not graduating high school)}} = B_0 + B_1 X_1 + \ldots + B_i X_i$$

As I described in Chapter 1 and in the theoretical model I adopted for this study, the variables I selected for this study are relevant predictors of high school graduation or the lack thereof in previous research. Specifically, the predictor variables I adopted are (a) demographics (gender, race, SPED, ELL status) and (b) academic experiences (attendance, behavior, and

coursework). Logistic regression results give significance level of the total model, the "goodness of fit" of the model and the odds ratio for each variable (predictability of each individual variable).

For the purpose of this study I examined and included only the main effects and not interactions among the variables I considered. I adopted this approach, as the main effects would constitute the "practical focus" of the way in which the district would identify students at risk for not graduating from high school and subsequent interventions. I next describe the steps I followed to establish the logistic regression model for the study.

Step 1. Univariate analyses were completed to for each predictor variable to determine the relevance for each variable for the multivariate model. Results of the likelihood ratio (LR) test and Wald test were examined to test the significance of each predictor. Any variable with a p-value of less than 0.05 was included in the first multivariate model.

Step 2. I ran a multivariable model containing all variables identified in step 1 to assess the importance of each variable using the p-value of the Wald statistic. The only variable left out from Step 1 was Gender. Variables that did not contribute at traditional levels of significance (.05) were eliminated and a new model fit. Then the reduced model was compared the to the full model using the likelihood ratio test and Akaike Information Criterion (AIC). I kept the full model based on the results presented in the next chapter.

Step 3. Next, I added each variable not selected in Step 1 to the model and checked for the statistical significance at p = <.001. Gender, which was excluded from the multivariate model, was added in to see if it significantly contributed to the model, but did not. Thus it remained excluded from the multivariate model.

Step 4. In this step, I evaluated the fit of the final logistic regression model with the predictive power (Cox-Snell pseudo R^2 and classification summaries) and goodness of fit statistics (Hosmer-Lemeshow test). The interpretation of R^2 was an effect size where values of .01 = small, .09 moderate and .25 large. The goodness of fit statistic is a formal test of the null hypothesis that the fitted model was correct. The output is a p-value, with a higher value indicating better fit. A p-value less than .05 would indicate that model was not acceptable.

Step 5. Finally, I interpreted the coefficients for overall fit to the model. For the purpose of this dissertation study p-values was set to .05, where a p-value of less than .05 was considered statistically significant.

CHAPTER III

RESULTS

The purpose of this chapter is the present the results from the study. I address the results by each research questions. Tables 6 and 7 address Research Question 1 and Tables 8 through 13 address Research Question 2.

Research Question 1: What are the demographics of graduates and non-graduates?

Table 6 presents means and standard deviations for predictor variables (a) gender, (b) race, (c) ELL status, (d) SPED status. The lowest mean is ELL status.

Table 6
Means and Standard Deviations for Demographic Variables

	Mean	SD	Minimum	Maximum
Gender	0.51	0.50	0	1
Race	0.14	0.35	0	1
ELL Status	0.03	0.17	0	1
SPED status	0.15	0.35	0	1

Table 7 presents demographics in percentages for Cohort 1, Cohort 2 and total sample. Each cohort was similar size (N=1,013 to N=1,028). Cohort 2 had more SPED (16.15%) and ELL students (3.70%), compared to cohort 1 with 13.13% SPED and 2.17% ELL. Aside from these small differences, visual inspection of the table reveals the cohorts were similar in demographics characteristics.

Students categorized as graduates and non-graduates varied in demographics. In the total sample 53.06% of graduates were female. SPED students represented with 20.27% of non-graduates, where graduates had only 11.49% SPED students. ELL students represented 2.15% of graduates and 4.45% of non-graduates. Non-White represents 12.48% of graduates and 16.73% of non-graduates. Overall graduates were females (53.06%), White students (87.52%), non-ELL students (97.85%) and non-SPED students (88.51%).

Table 7

Demographics Presented in Percentages for total sample, Graduates and Non-Graduates

	Cohort 1			Cohort 2			Total Sample		
	% of Total Cohort (*N*=1013)	% of Graduates (*n*=661)	% of Non-Graduates (*n*=352)	% of Total Cohort (*N*=1028)	% of Graduates (*n*=645)	% of Non-Graduates (*n*=383)	% of Total Cohort (*N*=2041)	% of Graduates (*n*=1306)	% of Non-Graduates (*n*=735)
Gender									
Male	48.57	47.96	49.72	48.74	45.89	53.52	48.65	46.94	51.70
Female	51.43	52.04	50.28	51.26	54.11	46.48	51.35	53.06	48.30
Race									
White	85.09	87.14	81.25	86.87	87.91	85.12	85.99	87.52	83.27
Non-White	14.91	12.86	18.75	13.13	12.09	14.88	14.01	12.48	16.73
ELL Status									
No	97.83	98.64	96.31	96.30	97.05	95.04	97.06	97.85	95.65
Yes	2.17	1.36	3.69	3.70	2.95	4.96	2.94	2.15	4.45
SPED Status									
No	86.87	89.41	82.10	83.85	87.75	77.55	85.35	88.51	79.73
Yes	13.13	10.59	17.90	16.15	12.25	22.45	14.65	11.49	20.27

Research Question #2: What combination of variables best predicts high school graduation in four years?

The results for this question are presented in Tables 8 through 13. Table 8 reports the frequency counts for attendance for the entire groups of students included in this study. Attendance ranged from 38% to 100%, with the majority (64.7%) of students with attendance between 91% and 100%. Only 2% of the sample attended school less than 70% of the time.

Table 8
Frequency Counts for Attendance

Attendance Percentage	Frequency	Percentage
31-40	3	0.00
41-50	2	0.00
51-60	9	0.00
61-70	29	1.0
71-80	128	6.0
81-90	548	26.8
91-100	1322	64.7

Valid cases 2041, Missing Cases 0

Table 9 presents the frequency counts for office discipline referral (ODR). Students in this study received between 0 and 11 ODR's, with 87.5% of student receiving 0 ODRs.

Table 9
Frequency Counts for ODRs

Value	Frequency	Percent
0	1786	87.50
1	103	5.00
2	30	1.50
3	13	0.60
4	5	0.20
5	11	0.50
6	3	0.10
8	1	0.10
11	1	0.00

Valid cases 2954, missing cases 87

Table 10 presents the frequency counts for course failure in both mathematics and English language arts. Of the total sample 71.8% of students didn't receive any F's in either subject.

Table 10
Frequency Counts for Course Failures

Value	Frequency	Percent
0	1466	71.80
1	199	9.80
2	105	5.10
3	71	3.50
4	53	2.60
5	29	1.40
6	33	1.60
7	22	1.10
8	19	0.90
9	11	0.50
10	9	0.40
11	6	0.30
12	7	0.30
13	4	0.20
14	4	0.20
15	2	0.10
17	1	0.00

Valid cases 2041, Missing cases 0

Table 11 presents descriptive statistics for the predictor variable of (a) attendance, (b) behavior, and (c) coursework for each grade level. From these descriptive statistics it may be seen that yearly attendance rates and course failures stay relatively constant over the three years. ODR's and out of school suspensions both increase from 7th grade to 8th grade as indicated by the 7th grade mean (0.16) and the 8th grade mean (0.27).

Table 11
Descriptive Statistics by Grade Level

	6th Grade		7th Grade		8th Grade	
	Mean	SD	Mean	SD	Mean	SD
Yearly attendance rates	0.94	0.05	0.93	0.05	0.93	0.05
Office discipline referrals	NA	NA	0.06	0.43	0.11	0.49
Out of school suspensions	NA	NA	0.16	1.08	0.27	1.31
Course failures	0.34	1.06	0.33	0.89	0.35	0.93

Table 12 presents descriptive statistics for predictor variables of (a) attendance, (b) behavior, and (c) coursework for this study.

Table 12
Predictor Descriptive Statistics

	Mean	SD	Minimum	Maximum
Attendance rate	0.90	0.07	0.38	1.00
Office discipline referrals	0.16	0.77	0	16
Out of school suspensions	0.41	1.94	0	29
Course failures	0.97	2.25	0	17

Table 13 presents actual observed graduate status crossed with predicted status from the final model. The final model included seven-predictor variables (a) race, (b) ELL status, (c) SPED status, (d) attendance, (e) ODR's, and (f) course failures. This model correctly predicted 65.9% of the observed graduation status outcome. Of the 736 students in the study who did not graduate on time, the predictive model correctly identified 247 (33.6%) of the students. Of the 1,305 students in the study who graduated on time the model correctly identified 1,171 (89.7%).

Table 13
Classification

	Predicted		
	Non-Graduate	Graduate	Percentage Correct
Non-Graduate	247	489	33.6
Graduate	134	1171	89.7
Overall Percentage			65.9

Table 14 presents the inter-correlations of the predictor variables in this study. One issue of multicollinearity was found with ODR's and suspensions. The correlation (r = .90) was large enough that issues of multicollinearity were of concern, meaning the two variables ODR's and suspensions were measuring the same thing. As a result, out of school suspensions variable was dropped as a predictor variable for the study.

Table 14
Inter-correlations of predictor variable

		1	2	3	4	5	6	7	8
1	Gender	1.0							
2	Race	-.01	1.0						
3	ELL	-.05	.43	1.0					
4	SPED	-.10	.03	.08	1.0				
5	Attendance rate	.01	-.01	-.01	-.11	1.0			
6	Office discipline referrals	-.12	.01	.00	.09	-.15	1.0		
7	Out of school suspensions	-.11	.02	-.01	.08	-.16	.90	1.0	
8	Course failures	-.11	.08	-.03	.05	-.26	.12	.14	1.0

Table 15 presents the results of the univariate analysis of each predictor variable. All predictors, with the exception of gender, were statistically significant predictors of graduation status. Gender had a p-value of 0.05, a beta of 0.1809, and a 95% confidence interval of 1.00-1.43, which indicated it was not statistically significant to predict high school graduation.

Table 15
Univariate Analysis

	Likelihood Ratio Test				
Predictor	χ^2	p-value	Beta	Odds Ratio	95% CI
Gender	3.85	.050	.1809	1.20	1.00-1.43
Race	7.96	.005	-.3670	0.69	0.54-0.89
ELL	9.18	< .001	-.7983	0.45	0.25-0.75
SPED	29.24	< .001	-.6860	0.50	0.39-0.64
Attendance rate	231.98	< .001	.1075	1.11	1.10-1.13
Office discipline referrals	33.20	< .001	-.4008	0.67	0.57-0.78
Course failures	63.70	< .001	-.1646	0.85	0.81-0.89

Note: $p < .001$ are significant and $p < .05$ is not significant

Table 16 presents the final multivariate model. Gender is excluded from the model as it failed to demonstrate a statistically significant effect predicting graduation status in the univariate model. In this model, two variables that made a non-significant contributions were removed, race (p=0.1470) and ELL status (p=0.0877) to produce a reduced model. The log likelihood of the reduced model was 1197.62 compared to the log likelihood of the full model at 1193.20. Retaining the larger model was also confirmed with the AIC, which was lower (2400) in the full model compared to the reduced model (2405). The AIC was used to estimate the quality of each model and a lower number indicates a better quality model. Therefore, the full model with race and ELL status was retained.

Gender, which was excluded from the initial multivariate model, was added in to the model to see if it contributed to additional explanatory power, but it did not (estimate = 0.074, SD = 0.10, Wald Chi-square = 0.55, p = .458). Thus, gender was excluded from the final multivariate model.

The final logistic regression model included (a) race, (b) ELL status, (c) SPED status, (d) attendance rate, (e) ODRs, (f) course failures and (g) SPED by Attendance interaction. The Cox-Snell pseudo R^2 for the final model was 0.129. This indicates the model accounts for approximately 13% of the observed variance in the outcome, which is a moderate effect (.01 = small, .09 moderate and .25 large).

The Hosmer-Lemeshow goodness of fit test was statistically significant (χ^2 [8] = 22.84, p = .004). The models were re-run to restrict the sample based on cohort. When restricted to cohort 1 the Hosmer-Lemeshow goodness of fit test was non-significant (p = .121) and it was also non-significant with cohort 2 (p = .104). Adequate fit for each cohort was found because the p-value was greater than .05 for both models.

Table 16
Multivariate Model

Predictor	Estimate	SE	Wald χ^2	p-value
Intercept	-7.7651	0.7442	108.8752	<.0001
Race	-0.2244	0.1547	2.1032	0.1470
ELL	-0.5328	0.3120	2.9155	0.0877
SPED	-0.4822	0.1373	12.3350	0.0004
Attendance rate	0.0953	0.00817	136.1296	<.0001
Office discipline referrals	-0.2039	0.0790	6.6562	0.0099
Course failures	-0.0843	0.0227	13.7955	0.0002

Log likelihood = 1193.20

The logistic regression analysis was conducted to predict high school graduation with six-predictor variables (a) race, (b) ELL status, (c) SPED status, (d) attendance, (e) ODR's, and (f) course failures. The statistically significant predictors in the final model, the ones that best predicted graduates are (a) attendance, (b) ODR's and (c) course failures, and (d) SPED. Although race and ELL status contribute to the overall fit of the final model, the estimates are not interpreted because their estimates are not statistically significant. A test of the full model against a constant only model was statistically significant, indicating that the predictors as a set reliably distinguished between graduates and non-graduates.

The sensitivity of the final model, the probability that the model indicated *graduate*, among those who actually did graduate, was 89.7%. The specificity of the model, the probability that the model indicated *non-graduate* among those who actually did not graduate, was 33.6%. The overall model correctly predicted the status for 69.5% of the students. The model correctly identified those who graduated better than those who did not.

CHAPTER IV

DISCUSSION

The current study analyzed retrospective, longitudinal student data from the fifth largest school district in Oregon to create an Early Warning Indicator System (EWS) to identify students on track to graduate and those who are not. These finding are discussed by research question in the following section.

Summary of Results

Research Question 1 addressed the demographics of graduates and non-graduates in the study, specifically noting the differences between groups to identify patterns among student demographics. A greater number of graduates were in the following groups: (a) females (compared to males), (b) White (compared to non-White), (c) non-ELL (compared to ELL), and (d) non-SPED (compared to SPED). The number of ELL students graduating within 4 years was about half that of non-ELL students. The number of SPED students graduation in 4 years was about half that of non-SPED students. These results were consistent with the previous research that identifies students in subgroups of SPED and ELL, which presents lower graduation rates in the nation (Rumberger, 1987, 2004).

Research Question 2 addressed the combination of variables that best predicts high school graduation in four years. The final model included six-predictor variables (a) race, (b) ELL status, (c) SPED status, (d) attendance, (e) ODR's, and (f) course failures. The demographic variables of gender and race, did not predict graduates as well as of the status variables of ELL or SPED. The variables of (a) attendance, (b) behavior, (c) coursework, and (d) SPED were stronger predictors than the demographic variables of race and gender. Next I will break down results by each variable.

Attendance plays an important role for high school graduation for all students. For every 10% increase of attendance a students' odds of graduation increased 193%. Increased attendance increased the odds of graduation in four years.

The behavior variable, measured by number of office discipline referrals, showed a decrease in graduation with each ODR received. The odds of graduation within 4 years were four-fifths less for each ODR. Since there was problem with multicollinearity between the ODR variable and days suspended, the model did not use the number of days suspended in the final model. An increased number of office discipline referrals decreased the odds of graduation.

The coursework variable, represented by the number of course failures in English language arts and mathematics, decreased the odds of graduation for each F. After controlling for the variables in the model the odds of graduation within 4 years was about nine-tenths less for each course failure. An increased number of failing grades decreased the odds of graduation

Demographic variables were also part of the final model. Although the descriptive statistics showed a higher percentage of females graduating in four years, gender was excluded in all models because it was not statistically significant in predicting graduation. Race and ELL status contributed to the overall fit of the final model, but were not statistically significant when considered in the model. Students identified as SPED presented lower odds of graduation in four years.

Discussion of Results

The finding that attendance is a predictor matches the findings from four of the studies reviewed in the literature synthesis (Gleason & Dynarski, 2002, Johnson & Semmelroth, 2010, Mac Iver & Messel, 2013, Schoeneberger, 2012). Chronic absenteeism is defined as attending 90% or less of school during a year (Balfanz, et al., 2007, Schoeneberger, 2012). Previous

research identified 75% or more of students fail to graduate if they attend less than 80% of school (Balfanz, et al., 2007, Henry et al., 2012, Johnson & Semmelroth, 2010, Mac Iver & Messel, 2013). My study looked at 10% increments of attendance and found that with each increase of 10%, the odds of graduation increased.

In this study behavior was not as strong as predictor as attendance, but with each ODR event, students' odd of graduation did decrease. Behavior was identified as an indicator of graduation in six studies I reviewed (Balfanz et al., 2007, Barry & Reschly, 2012, Mac Iver & Messel, 2013, McIntosh et al., 2008, Soland, 2013, Suh & Suh, 2007). Previous research has used different variables to measure behavior including (a) teacher assigned grades (b) office discipline referrals, and (c) number of days suspended, the current study only looked at office discipline referrals. Using a variety of measures could help future shape interventions and identify the high-risk behaviors to derail students from the graduation path. Deeper analysis is needed to see if ODRs considered as "major" vs. "minor" reflect a difference for students' paths to graduation.

In the research I reviewed for this dissertation, students who failed English were 42% less likely to graduate and students who failed mathematics were 54% less likely to graduate than students passing mathematics and English (Balfanz et al., 2007). Johnson and Semmelroth, 2010 found the number of course F's had the highest sensitivity level at 87% compared to other variables. The current study found odds of graduation within 4 years was about nine-tenths less for each course failure.

From the results, it is clear, the ABC's (a) attendance, (b) behavior, and (c) coursework are important to stay on track to graduation. Creating an effective EWS requires development of data collection, organization, and operational practices in analyzing. Once schools develop

systems to routinely look at data and understand it, they need to shape interventions to meet the needs of students. Once interventions are in place, a plan to collect data on interventions is needed to adjust instruction and ensure it is working. Districts need to spend resources to effectively train schools on this process.

This study specifically looked at successful graduation and correctly identified those who graduated with 89.7% accuracy. More development to refine this prediction model to not only successfully predict graduates, but also to successfully predict non-graduates is needed. This model only predicted non-graduates with 33.6% accuracy. Prediction alone will not improve graduation rates, teaching schools how to use the data and pinpointing effective interventions is the next step of this work. Decreased budgets and less time make this work even more important. We need cost effective ways to intervene with students that truly need interventions

Limitations

Despite the possible usefulness of the results from this study, the limitations should be considered. First, it should be noted, I constructed this study specifically for the Bend-La Pine School District. Although these results might not be generalizable to other districts or states, the results are reflective of the district and will help to create a meaningful system for the Bend-La Pine school district.

First, a main limitation of the study was that GPA and Socioeconomic Status were not included in the analysis. GPA and Socioeconomic Status were identified in the literature review as predictor variables, but the district was unable to provide these data. Socioeconomic Status was provided for the cohort, but could not reported on the individual student level.

Second, in this study, the graduation statistic was adopted instead of dropout. There are several alternatives to a high school graduation (e.g., earning a Graduate Equivalency Degree,

graduating in more than four-years) that I did not consider. Examining only the four-year graduation rate may have over-represented non-graduates.

Third, the missing data procedure, single imputed dataset, may be limited as a single data set was imputed, treating the imputed values as true values. Rubin (1987) has shown that variance estimates based on imputed data is usually underestimated, resulting in artificially low standard errors and higher Type-I errors.

Finally, this study used two cohorts of students who were only one year apart in school years. The cohorts were similar in terms of demographic characteristics and possessed little diversity. There may have been more differences seen between cohorts if there would have been more time between each cohort as different education initiatives may influence graduation rates.

Implications for Future Development and Application

Improving graduation rates is a national problem, one in which Oregon has the unfortunate distinction of being at the very back of other states. Increased pressure to improve graduation rates while budgets are shrinking escalates the need for a valid prediction and intervention system to identify students for meaningful and efficient interventions. Future research is needed to understand successful interventions to put students back on the path to graduation. Waiting until high school is too late to start identifying students at-risk not to graduate. The more we know about graduates as well as non-graduates will assist in developing effective interventions. All students will benefit from additional support as they navigate the path to graduation. The cost of providing support for students' misidentified at-risk students is a small cost to improve graduation rates.

Further research is needed to develop a meaningful early warning system that accurately identifies at-risk students as early as possible based on data and to offer timely interventions to

students in need. The research to this point has narrowed down (a) attendance, (b) behavior, and (c) coursework are indicators to successful graduation. This study concludes in these indicators, good attendance has the highest odds to improve high school graduation. For Oregon to meet President Obama's goal to increase the K-12 graduation rate to 90% by 2020 (Balfanz, Bridgeland, Bruce & Fox, 2012), as well as meeting Oregon's goal of 40-40-20, we need to not only create local models, but shape interventions to put students back on track to graduation.

Appendix A

Summary of Subjects

		Subjects			Grade Level		
Study	*N*	Students	Teachers	Parents	Elementary	Middle	High
1	11,827	X				X	
2	13,000	X				X	
3	201	X	X		X		
4	193	X			X		
5	5,480	X				X	
6	911	X				X	
7	372	X					X
8	21,686	X		X		X	
9	169,953	X			X		
10	7,431	X					X
11	14,541	X					X
12	330	X				X	
13	30,099	X			X		
14	9,482	X	X			X	
15	6,192	X					X
Total		15	2	1	4	7	4

Appendix B
Summary of Measures

Citation	Attendance	Behavior	Suspension	Grades	Overage	Tests	Graduation Rates	Dropout Rates	Demo-graphics
1								X	
2	X	X	X	X		X	X		X
3	X	X		X		X		X	X
4				X				X	X
5					X			X	
6	X		X			X		X	
7	X			X			X	X	
8								X	X
9	X			X		X	X		
10			X					X	
11	X	X	X	X	X			X	
12		X		X		X			
13	X							X	X
14	X	X	X	X			X	X	X
15	X	X	X	X			X	X	X
Total	9	6	6	9	2	5	5	12	7

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