AN ABSTRACT OF THE DISSERTATION OF

Jeffery R. Ring for the degree of Doctor of Philosophy in Education presented on January 4, 2017.
Title: Successful Learning Rate as an Indicator of Student Success Rates: A Correlational Study

Abstract approved:

Darlene F. Russ-Eft

At the intersection of higher education and politics, there is demand for an easily understood measure of student success. Graduation rate is the current measure of choice, but the definition of graduation rate excludes many categories of students and types of success particularly applicable to community colleges. The purpose of this study was to explore the Successful Learning Rate (SLR) as a possible measure and predictor of student success. The SLR is the ratio of courses passed to courses attempted, e.g., three courses passed to four courses attempted yields an SLR of 3:4 or .75. The SLR includes more categories of students than graduation rate does, and it defines success along the way, not just at the end point of graduation. The research questions were:

1. To what extent does the SLR, measuring progress course-by-course, correlate with eventual graduation within 150% of the normal time to completion?

2. To what extent does the SLR vary in relation to student characteristics?

3. In that way does a correlation between the SLR and Graduation Rate suggest changing the definition of "normal time to completion" and the existing 150% threshold?

The setting for this study was a mid-sized suburban community college enrolling approximately 30,000 students annually. Historical transcript data for 51,115 students were tracked between 2003 and 2013. The study used a quasi-experimental correlational design. Regression analysis was applied to selected variables to determine the relationship of student characteristics with SLR and with eventual graduation.

Data collection involved gathering historic transcript data as provided by the college's institutional research staff, with some data excluded as beyond the scope of this study. The SLR was calculated for every term during which the student was registered. The data were examined in various combinations using biserial correlation, Mann-Whitney U tests, and logistic regression. Due to the large number of students studied ($N = 51,115$), significance was set at $p < .001$.

Biserial correlation revealed an almost negligible relationship between SLR and eventual graduation ($r = 0.082$). Mann-Whitney U tests revealed that the SLR of male students and female students did not differ significantly, $p = .180$. The mean SLR of part-time students ($M = .91$, $SD = .25$) was significantly higher than the mean SLR of full-time students ($M = .83$, $SD = .28$), $p < .001$. The mean SLR of non-traditional age students ($M = .91$, $SD = .24$) was significantly higher than the

mean SLR of traditional age students ($M = .83$, $SD = .29$), $p < .001$. Among students who did graduate, logistic regression was used to explore relationships among variables. Gender was not a significant predictor, $p = .307$. The SLR was a significant predictor, $OR = 1.065$, $p < .001$, 95% CI [1.045 1.086], as was the student's attendance type $OR = 0.370$, $p < .001$, 95% CI [.317 .432], and the student's age, $OR = 0.809$, $p = .015$, 95% CI [.682 .960].

This study demonstrates that there is an almost negligible relationship between SLR and eventual graduation. In no analysis was gender a significant factor or predictor. Among those students who do graduate and in order of strength, (a) part-time attendance, (b) a higher SLR, and (c) non-traditional age were the most significant predictors of graduation.

On paper, the SLR meets the criteria of a "good indicator." In practice, it may be a good indicator of student success when combined with other indicators. Future research should look at the SLR over a larger student population and as applied to specific academic disciplines. Rather than examining the measure with only one institution, it would be useful to compare different institutions with different institutional and student characteristics. Further, it would be useful to examine the SLR of full-time non-traditional age students, as well as students with other characteristics. These factors may reveal correlations not evident in this study, and the SLR may yet prove to be a useful predictor of eventual graduation.

Successful Learning Rate as an Indicator of Student Success Rates:
A Correlational Study

by
Jeffery R. Ring

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

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Jeffery R. Ring, Author

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CONTRIBUTION OF AUTHORS

Weidan Zhou, consultant with Elite Research, LLC, provided statistical mentoring, calculations, and review of Manuscript 2.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF APPENDIX TABLES

DEDICATION

This dissertation is dedicated to my mother. Mom, thank you for reading to me as a child. That gift opened up the whole world to me in ways you may never have imagined.

Chapter 1: General Introduction

Successful Learning Rate as an Indicator of Student Success Rates:
A Correlational Study

Jeffery R. Ring and Darlene F. Russ-Eft

Abstract

Graduation rates are used as a proxy measure for institutional success in educating

students. Only degrees completed in 150% of the traditional time (e.g., two-year

degrees completed in three years) by students enrolled full-time count toward

graduation rates as defined by the US Department of Education. Community

college students enroll with a variety of life circumstances and educational goals,

many of which do not involve graduating or earning a degree: vocational training,

job skills training, transfer to another institution, etc. Graduation rates therefore do

not fully describe community college success.

    The purpose of this study was to examine an alternate indicator of success,

the Successful Learning Rate, as it applies in community colleges. Specifically,

this study examined whether the Successful Learning Rate correlates in any way

with eventual graduation. This study has implications for policymakers and

practitioners alike.

    Keywords: Successful Learning Rate, graduation rate, community college,

student success, higher education, policy implications

Successful Learning Rate as an Indicator of Student Success:
A Correlational Study

Since the passage of the *Student Right-To-Know and Campus Security Act of 1990*, all institutions of higher education are required to provide data on graduation rates. Graduation rates are calculated based on the number of students entering an institution as first-time, full-time, self-declared degree/certificate-seeking students who complete their degree/certification in 150% of the "normal time to completion" (U.S. Department of Education, 2016), e.g., a program that can be completed in two years of full-time study can only count graduates who have completed in three years or less (U.S. Department of Education, 2013a). It is intended that students, parents, counselors, and others will use these data to make comparisons among institutions. The implicit suggestion to education consumers is that institutions with higher graduation rates are more successful in educating their students than those with lower graduation rates (Astin, 2005).

There is a wealth of research into the links among student characteristics, institutional characteristics, and graduation rates (Hagedorn, 2005; Horn & Carroll, 2006; O'Conor, 2009; Sorey & Duggan, 2008; Tinto, 1988, 1993; Volkwein & Lorang, 1996; Yorke, 1999). Given the complex relationships among those factors, it is reasonable to question whether graduation rate is a reliable indicator of success, particularly when applied in community colleges (Burd, 2004; Hagedorn, 2005; Muhndhenk, 2000; Rice & Russell, 2012). For example, institutional selectivity is not a characteristic of community colleges; these

institutions traditionally accept all applicants, even those not prepared for college-level work (Bailey, Calcagno, Jenkins, Leinbach, & Kienzl, 2006; Scott, Bailey, & Kienzl, 2006). Characteristics of community college students vary in comparison to the characteristics of students at four-year institutions (Bailey, Alfonso, Scott, & Leinbach, 2004).

Students attending institutions other than community colleges have different educational outcomes available to them, i.e., earning a bachelor or master's degree. Students who attend four-year institutions arguably are focused on earning a degree. Students who attend two-year institutions have different choices available to them: vocational training, certification in an applied field, transfer to another institution, or the associate's degree. Of these two-year outcomes, achieving a certificate or an associate's degree are the only outcomes that count toward graduation rates according to the definitions used by the U.S. Department of Education. Vocational training, for example, does not count toward the institution's graduation rate. While the student may have achieved the desired educational outcome, that outcome is not a measurable graduation according to current standards (Bailey, Calcagno, Jenkins, Leinbach, & Kienzl, 2006; Hagedorn, 2005).

Premise of Research

The premise of this study is that graduation rate is an inadequate indicator of success in community colleges (Astin, 2005; Hagedorn, 2005; Rice & Russell, 2012; Smith, 2016). Graduation rate is a limited indicator of student success,

which itself is used as a proxy for inferring institutional success. The *Successful Learning Rate* (SLR) describes student success in a different way. It describes progress along the way, not just at the end of a sequence of courses leading to graduation. This is a more flexible and descriptive indicator that better accounts for community colleges' multiple missions to serve all students, regardless of individual educational goals (Rice & Russell, 2012).

Purpose of Study and Research Questions

The purpose of this study was to examine whether the SLR might be used as an indicator of success and as a predictor of eventual graduation. The SLR was tested at a medium-sized community college against pre-existing datasets of historical transcript records.

The *Student Learning Progress Model* was developed by Dr. Gary Rice (2010) at the University of Alaska-Anchorage. The component of the model that was tested in this study is the SLR.

> Success is determined by official certificates and degree awards completed by all students over ten years, as well as levels of successful learning performance for non-degree seekers. The central metric for this assessment is the Successful Learning Rate (SLR) or ratio of courses successfully completed with a passing grade to total courses attempted (p. 2).

The Student Learning Progress Model is designed to respond to limitations imposed by the traditional graduation rate. It incorporates more students than are traditionally counted in graduation rates: the SLPM includes all students, not just those who are first-time, full-time, degree-seeking students. It tracks student

progress over 10 years, widening the window for countable successful graduations. It is designed to refocus accountability for student success on the institution's instructional mission. It recognizes the value-added learning progress of all students. It is student outcome-centered, and it permits the examination of success among sub-cohorts (Rice, 2010).

In recognition of the varying characteristics and educational goals of community college students, this study included all registered community college students over a 10-year period in a medium-sized suburban community college. This expands greatly on the traditional metric, which only counts first-time, full-time, degree-seeking students who enrolled in a fall term. Further, this study examined student achievement beyond the traditional 150% degree-completion time frame.

The specific research questions examined were these:

1. To what extent does the Successful Learning Rate, measuring progress course-by-course, correlate with eventual graduation within 150% of the normal time to completion?

    Ideally, there might be a correlation between a higher SLR and eventual graduation. If so, one may infer that a higher SLR shows that students have greater potential for graduation. Students with lower SLRs, on the other hand, may benefit from targeted support systems to help them achieve graduation.

2. To what extent does the Successful Learning Rate vary in relation to student characteristics?

   Students make judgments about balancing their work, family, and school obligations. Some students dive in as full-time students so that they can achieve their goals in the shortest amount of time and with the least amount of student debt. Other students make different choices: some take fewer courses at a time so that they can maintain excellent grades, work while attending school, or attend to family responsibilities. In the literature they are referred to as "extenders," and they confound graduation rates by intentionally making slower than normal progress (Volkwein & Lorang, 1996). Further, some students attend college with no intention of earning a degree or certificate; these students may be planning to transfer or to take a few courses for professional development (Nelson, 2010).

3. In what way does a correlation between the Successful Learning Rate and Graduation Rate suggest changing the definition of "normal time to completion" and the existing 150% threshold?

   Students who take longer than 150% of the normal time to completion may take remedial (non-college-level) coursework or may be students with disabilities (Ponticelli & Russ-Eft, 2009). Many community college students begin their college careers with some

remediation necessary. Bailey, Jeong, and Cho (2010) report that various studies show between 43% and 59% of community college students enroll in at least one remedial course. These students start out behind; and although they may eventually graduate, they may not be able to do so in 150% of the normal time to completion. These students were not unsuccessful by any measure; by some measures their instructors would consider them highly successful for finishing at all. If there were a correlation between SLR and eventual graduation, it could be useful to identify that relationship and use it to calculate a more realistic timeframe to graduation for community college students.

Significance

From the perspective of simple practicality, this research is significant for several reasons. First, the study can assist decision-makers at community colleges in focusing resources to improve student outcomes. Second, it provides useful marketing information for colleges. Third, it addresses social justice issues. Fourth, it contributes to understanding community college student persistence. Fifth, it adds another metric to measure community college student success. And last, it tests an alternative model for measuring student success.

Improve student outcomes. Lee and Buckthorpe (2008), recognizing that students may change tracks or programs, pointed out the importance of using indicators that allow for easy comparisons across courses and programs. Students may start full-time, reduce to part-time, change to a different specialty within the

same program, change to a new program, stop out for personal reasons, and restart later. Because the SLR looks at individual student learning success over a 10-year period, collecting and analyzing student-level data may reveal previously unrecognized relationships among variables that can serve as predictors of student success.

The model was tested at a local community college. Finding more nuanced means of describing student success assists decision-makers in aligning instructional and support programs with student achievement goals. Examining the SLR in various program areas (e.g., math, writing, history) might provide insight to faculty and administrators when designing courses and programs. For example, administrators and faculty in programs with lower SLRs may use this information to redesign prerequisites, courses, and programs to achieve higher SLRs.

Provide marketing information. Astin (2005) pointed out that students and parents are encouraged to make comparative judgments about colleges based on graduation rate. They are encouraged to assume that a college's graduation rate is an indicator of the individual student's likelihood of graduating.

Mundhenk (2000) discussed the need for community colleges to tell the stories of their successes in more effective ways than through the use of graduation rates. Additional indicators of effectiveness are needed. By quantifying learning success, community colleges can speak more broadly about success in all of their

various missions: remedial education, vocational education, workforce development, certification, college-transfer, and others. This provides students and families with more useful information about learning outcomes when selecting a college. This type of information can be a useful marketing tool for the college.

Address social justice issues. This topic is meaningful from the perspective of social justice. It is patently unfair to label students as "unsuccessful" when they never intended to earn a degree or did not earn a degree within an arbitrary timeframe. Many community college students have short-term goals in mind when they enroll: taking a database class may be exactly what students need to upgrade skills and earn a promotion at work (Mundhenk, 2000; Smith, 2016). If the student earns the promotion, the student has achieved the goal. Yet because these students did not earn a degree, the U.S. Department of Education considers them to be unsuccessful and the institution to be unsuccessful. This does not provide social justice to that student nor to the institution serving that student.

Contribute to understanding community college student persistence. While considerable research has been conducted about student retention and persistence and their effects on graduation rate (Adelman, 2004; Astin, 2004; Bailey, Jenkins, & Leinbach, 2007; Horn & Carroll, 2006; O'Conor, 2009; Scott, Bailey, & Kienzl, 2006; Tinto, 1988, 1993), most studies have been limited in a number of ways. Astin (2004, 2005), Braxton (2000), and Horn and Carroll (2006)

have focused their research on baccalaureate-seeking students, excluding community college students.

Other researchers (Bailey, Calcagno, Jenkins, Leinbach, & Kienzl, 2006; Garcia-Falconetti, 2009; Hagedorn, 2012; Sorey & Duggan, 2008) have begun to examine community college populations specifically, but the start is tentative at best; there is much more to be done to tailor existing models to the populations served by community colleges. In the political climate linking education and job creation, there is laser-like focus on community colleges as engines of economic and workforce development. Given this focus, much more must be done to understand success among community college students. This study expands the literature in this area.

Expand metrics on community college student success. More than a decade ago Mundhenk (2000) recognized the need for data that are more sensitive to student intent. Understanding that community college students might enroll in courses simply to upgrade job skills and not to achieve a degree, he posited that an accurate picture of community college student success would include data about both those who complete a degree and those who leave without completing a degree.

Mundhenk and others who have focused on community college students have limited their work to determinants of graduation outcomes (Bailey, Alfonso, Scott, & Leinbach, 2004; Bailey, Calcagno, Jenkins, Leinbach, & Kienzl, 2006;

Braxton, 2000; Habley & McClanahan, 2004); they have not studied alternate indicators of student success. This research addresses that gap in the literature.

Test an alternate indicator of student success. There appears to be a general consensus that community colleges need to use alternate indicators to adequately convey the ways in which they and their students are successful (Bailey, Calcagno, Jenkins, Leinbach, & Kienzl, 2006; Bailey, Crosta, & Jenkins, 2007; Bailey, Jenkins, & Leinbach, 2007; Calcagno, Crosta, Bailey, & Jenkins, 2007; Camp, 1991; Garcia-Falconetti, 2009; Hagedorn, 2005). While a number of authors have pointed out the limitations of graduation rate as an indicator of institutional success, few have proposed a working model to take its place (Cohen & Ibrahim, 2008).

The *Student Learning Progress Model* is a workable model, as evidenced by the faculty acceptance at the University of Alaska-Anchorage (Rice, 2010). The originator of the model seeks a rigorous examination of its application and scalability to community colleges. This study examined those aspects of the model, adding to the existing literature about indicators of community college success.

This work aligns with an effort by the federal government to develop national education measures. In 2009, the Group on Expanded Measures of Enrollment and Attainment (GEMEnA) was formed as part of the National Center for Education Statistics. One of the main strands of GEMEnA's work is to

"develop and deploy a core set of survey items related to the prevalence and key characteristics of subbaccalaureate educational certificates" (U.S. Department of Education, 2013b, "GEMEnA's Portfolio," para. 2).

Overview of the Dissertation

This chapter presents the Focus and Significance of the topic, along with the research purpose and questions. Chapter 2 / Manuscript 1 presents a review of the literature. Chapter 3 / Manuscript 2 presents the method, analysis, and findings of the study. Chapter 4 provides a conclusion, tying together the manuscripts' content, summarizing the findings, and looking ahead to future research.

Summary of Focus and Significance

Institutions of higher education report graduation rates to the U.S. Department of Education. The Department of Education publishes this rate, which is viewed as an indicator of institutional success: "The higher the graduation rate, the better the institution"… or so the thinking goes.

Community colleges face particular challenges when the graduation rate is applied as a one-size-fits-all indicator of institutional success. Community colleges serve a broad and varied student population that does not typically attain a degree in three years, if a degree is the goal at all. Because of the multiple simultaneous missions of community colleges, many students successfully achieve their goals without earning a degree.

There is general consensus among experts that community colleges need to develop new indicators of success that address their varied missions and the varied

educational goals of their students. The SLR offers a new approach to measuring outcomes in a way that includes all full-time, part-time, and non-degree-seeking students.

The purpose of this study was to examine how the SLR could be used as an indicator of student success. The study addressed the following questions:

1. To what extent does the SLR, measuring progress course-by-course, correlate with eventual graduation within 150% of the normal time to completion?

2. To what extent does the SLR vary in relation to student characteristics?

3. In what ways does a correlation between the SLR and Graduation Rate suggest changing the definition of "normal time to completion" and the existing 150% threshold?

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Chapter 2 / Manuscript #1:
Indicators of Student Success: A Review of the Literature

Jeffery R. Ring and Darlene F. Russ-Eft

Abstract

Graduation rates are generally accepted as indicators of institutional success, although they are an abstract proxy measure based on the aggregation of individual student success. As such, graduation rates are subject to many assumptions, and many caveats should be given when using graduation rates as a measure of success.

This review identifies four themes in the scholarly literature about indicators of student success: (a) characteristics of good indicators, (b) student characteristics affecting graduation rates, (c) institutional characteristics affecting graduation rates, and (d) existing course- and credit-based indicators of student success. Finally, there is a synthesis of the literature to suggest an alternate indicator of student success that offers greater nuance in telling the story of institutional success.

Keywords: Indicators, student characteristics, institutional characteristics, Success Ratio, DWI Index, Course Completion Ratio, Successful Learning Rate

Indicators of Student Success:
A Review of the Literature

It has become common for students, families, guidance counselors, and others to equate higher graduation rates with greater institutional success in helping students achieve their goals (Astin, 2005). Graduation rates, however, do not tell the full story of institutional success (Astin, 2004; Hagedorn, 2005a).

This literature review lays the groundwork for an examination of alternate indicators of success. Whereas graduation rates only include first-time, full-time, degree-seeking students who complete their program of study within 150% of the "normal time to graduation" (e.g., a two-year program completed in no more than three years) (U.S. Department of Education, 2016a), alternate indicators also include consideration of returning students, part-time students, and non-degree-seeking students. None of these characteristics is considered when calculating graduation rates (Bailey, Calcagno, Jenkins, Leinbach, & Kienzl, 2006; Hagedorn, 2012).

The purpose of the literature review is to frame the search for alternative indicators of success within the existing literature. Broadly, there are four themes that have emerged from the literature: (a) discussion about the development of appropriate indicators; (b) discussion about student characteristics that affect graduation rates; (c) discussion about institutional characteristics that affect graduation rates; and (d) discussion of four specific indicators: *Success Rate*, *DWI Index*, *Course Completion Ratio*, and *Successful Learning Rate* (SLR).

The first theme examined was literature about developing appropriate indicators of success. This theme established the characteristics of good indicators. Once this was established, it became possible to address the next theme.

The second theme examined was literature about student characteristics that affect graduation rates. If student characteristics affect graduation rates, it is possible that the same characteristics may affect any alternative indicators of success. Understanding how student characteristics may impact these indicators will inform the design of any proposed indicators, as well as related research. Once student characteristics were understood, it became possible to address the third theme.

The third theme examined was literature about institutional characteristics that affect graduation rates. If institutional characteristics affect graduation rates, it is possible that the same characteristics may also affect any alternative indicators of success. Understanding how institutional characteristics may impact these indicators will inform the design of any proposed indicators, as well as any related research. Once institutional characteristics were understood, it became possible to address the fourth theme.

The fourth and final theme examined was the evolution of calculated indicators. The *Success Rate*, *DWI Index*, *Course Completion Ratio*, and the *Successful Learning Rate* represent the evolution of indicators based on the

successful completion of credits and courses. These indicators have been applied

differently and have not been studied for their statistical significance as indicators,

nor have they been studied as to whether they may be used as predictors of

eventual graduation.

Approach to the Literature Review

The literature review itself was a multi-step, iterative process. Discussing

the topic of student success with two institutional researchers was the first step.

Dr. Gary Rice from the University of Alaska-Anchorage and Dr. Nancy Fair-

Szofran from Mt. Hood Community College (MHCC) initially presented the

Student Learning Progress Model to the MHCC deans at a special meeting. They

had been working to address shortcomings in using the graduation rate as an

indicator of MHCC's institutional success. Engaging the presenters in discussions

and reading a pre-publication article (Rice & Russell, 2012) highlighted important

concepts and keywords, and examining the article's bibliography yielded an initial

list of authors who also wrote on the topic.

The second step was taking those clues to the Oregon State University

Library. The library provided rich print and online resources that allowed a

comprehensive search on important keywords and on important authors and

articles. Searching for appropriate literature was largely an online endeavor.

Using the *Education Research Complete* database and the *ERIC* database (both via

the EBSCOhost interface) allowed retrieval of full-text copies of articles cited in

Dr. Rice's pre-published work. These articles provided the first iteration of the

literature review process.

These articles proved useful in three ways: (a) they provided further citations to related studies; (b) they provided a larger pool of researcher names for follow-up; and (c) they provided relevant keywords for further research.

Using the references from these articles was the second iteration of the literature review. Having nearly 100 citations to examine, patterns began to emerge. Certain authors seemed to write more prolifically on topics related to the current research; other authors seemed more tangentially related. A core group of authors began to emerge (e.g., Adelman, Astin, Bailey, Cabrera, Hagedorn, Tinto, Volkwein, and Yorke).

The third iteration of the literature review involved returning to *Education Research Complete* and *ERIC*. Through these databases it was possible to retrieve full-text copies of most articles identified in the second iteration. Likewise, using the Oregon State University Library's online catalog and its link to WorldCat, it was a simple matter of locating and requesting via interlibrary loan copies of articles and monograph titles not available online.

The fourth iteration of the process involved much reading. This stage of the process was about noting keywords, authors, and themes common to all resources. This stage marked a turning point from casting the net as widely as possible to focusing more narrowly on specific themes in the literature.

The fifth iteration of the process involved returning to *Education Research*

Complete, *ERIC*, *Educator's Reference Complete*, and *Dissertation Abstracts International*. Searching these resources with the most common keywords for the themes identified in the previous iteration yielded a large pool of resources. Searching the same databases with the names of the core authors also yielded a large pool of resources. Identifying resources that appeared in both result sets (keyword searching and author searching) yielded the most relevant resources.

The sixth iteration of the process involved examining the overlap pool of resources. Searching those specific citations in the *Web of Science* database allowed the creation of a citation map, linking articles and authors to one another. Finding which authors have cited which studies most frequently yielded a manageable pool of literature to review. It also allowed the themes to be focused more directly on literature relevant to the research topic.

After many iterations of reading and focusing the topic more narrowly, the penultimate step of the process was to create a personal database of resources. EndNote citation tracking and formatting software served as the database.

The final step of the process was to synthesize the literature into this literature review.

Justification for Inclusion or Exclusion of Literature

Using the citation mapping strategy uncovered not only recent literature about the topic, but it also revealed seminal works in the theme areas. The effect of institutional selectivity and student demographics on retention and persistence was largely the realm of Tinto, as well as others who cite his work. Graduation

rate as an indicator of student success was discussed largely by Adelman, Astin, and Horn and Carroll, as well as others who cite their work. Calls for different measures of success were made frequently by Astin, Bailey, Burd, Calcagno, and Horn and Carroll, as well as government and educational research and policy institutions: the National Center for Education Statistics, the Lumina Foundation, and the Data Quality Campaign, for example.

Examining this prior research provided an overview and theoretical framework for the present study. Examining the work of researchers who have cited core authors and seminal works provided more recent studies. Those studies clearly laid out limitations in the research that had been conducted as well as areas for further research.

Exclusion of literature took a more subtle form. First, research published in languages other than English was not reviewed. The focus of this study is specific to the American higher education system, and while there are some useful parallels in parts of the English-speaking world (e.g., Australia, Britain, Canada), education systems outside of the English-speaking world were generally considered to be too different to provide relevant comparisons.

Second, literature was excluded during the literature search process on a citation-by-citation basis. For example, initially promising research turned out to be only tangentially related upon deeper review. The author made a value judgment about the relevance and the weight of each study to this research.

Exclusion of particular research was not to be construed as an editorial comment about such research; rather, it was a matter of its relationship to the present study.

Third, most of the literature included was from sources less than 10 years old. Seminal works providing foundational theory were of course older. Because graduation rate has recently become a political topic, it has only started to be studied in a systematic way in the last decade or so.

Framing the quest for needed research required four initial steps: (a) understanding how indicators are developed; (b) understanding how student characteristics impact graduation rates; (c) understanding how institutional characteristics affect graduation rates; and (d) examining the evolution of particular indicators. After exploring these four themes, it became clear that further research was needed to inform the larger scholarly and policy discussions taking place.

Theme 1: Characteristics of Good Indicators

This literature review is based on calls for better indicators of student success beyond simple graduation rates (e.g., Astin, 2005; Bailey, Crosta, & Jenkins, 2007; Bradley, 2009). In order to develop and examine needed research in the area, it is important to understand what makes good indicators.

Indicators as abstractions. "Indicators arise from values (we measure what we care about), and they create values (we care about what we measure)" (Meadows, 1998, p. 2). Meadows defined indicators as abstractions of models, which are themselves abstractions of complex systems. She made the point that a

greater number of indicators yields more information about very complex systems than a single indicator, but indicators never perfectly describe the full functioning of a complex system. "The grade is not the knowledge in the head of the student" (p. 6).

She described indicators as either objective or subjective, quantitative or qualitative. She acknowledged that objective indicators are more easily verifiable by others; she preferred subjective indicators for their qualitative values. Meadows (1998) argued that all indicators are at least partially subjective insofar as they are selected based on a value judgment. She listed 15 characteristics of good indicators: (a) clear in value, (b) clear in content/easily understood, (c) compelling, (d) policy relevant, (e) feasible, (f) sufficient, (g) timely, (h) appropriate in scale, (i) democratic, (j) supplementary, (k) participatory, (l) hierarchical, (m) physical, (n) leading, and (o) tentative (pp. 17-18).

Many of these characteristics are self-evident. Some appeared to overlap, such as "timely" and "leading" (in the sense of "being ahead of the others"), both of which have to do with providing current information in enough time to act upon it. "Clear in content/easily understood" seemed to overlap with "hierarchical," in that hierarchical refers to the ability to look at macro-level information and drill down to micro-level information; if information were arranged hierarchically, it follows that it would be easily understood. Likewise "democratic" and "participatory" overlapped in meaning. "Supplementary" was vague when it stood

alone in a list; the author's definition of supplementary included information that people cannot measure directly for themselves, e.g., graduation rates. "Tentative" was the author's way of saying that indicators may be improved upon and are open to change as more information is discovered.

Indicators as applied in higher education. Meadows (1998) wrote in the field of sustainability studies, and her work was adopted by Cohen (2007) in his writing about higher education. Cohen brought Meadows's work on indicators into the higher education context while addressing the need for indicators of sustainability in educational institutions. He described three characteristics of indicators: (a) they should be based in systems thinking; (b) they should have an academic and practical grounding; and (c) they should be motivated by an ethic based on consciousness, empathy, compassion, and action. He described the critical role of institutional research in collecting and reporting data on indicators, although he acknowledged that many useful indicators (of sustainability) have yet to be identified.

Cohen's work was theoretical rather than empirical research. It was a call to adopt sustainability as an institutional value. While he put forth ideas about the characteristics of good indicators, he did not test them himself. This is an area where further research may be needed.

Indicators as academic outcomes. In the context of academic outcomes in higher education, Lee and Buckthorpe (2008) stated four criteria that determine

the utility of performance indicators: (a) they are calculated from recent data and able to produce annual trends; (b) they are calculated for any course or program of study, both full- and part-time; (c) they are stable enough that individual data points should not have a disproportionate effect on overall calculations; and (d) they are calculated clearly and correctly to give a true indication of student success. The authors particularly noted the importance of the clarity and veracity of the calculation; they clearly stated that there would be no point in having an indicator that does not allow for true comparisons across courses and programs of study.

Lee and Buckthorpe (2008) conducted their research specifically in the British higher education system. Given that their work was limited to that system, their conclusions may have limited applicability to the American system of higher education. Their discussion of the characteristics of good indicators, however, has theoretical application that may prove useful in future research.

Yorke (1999), also a researcher in the English higher education system, posed four fundamental questions that must be considered when contemplating the usefulness of performance indicators: (a) Who wants to know what? (b) For what purposes is the information to be used? (c) How valid and reliable are the indicators that are being used or are being proposed for use? and (d) Do the indicators have any side effects?

In particular, he noted that indicators used across higher education should

be neutral across types of institutions so as not to favor one type over another. He

noted the difficulty in achieving this in practice in an educational system where a

diversity of institutional types and missions is valued. For example, institutions

with missions to accept at-risk students may run the risk of lower completion rates

(Yorke, 1999).

Like Lee and Buckthorpe (2008), Yorke's (1999) practical research may

have limited applicability to the American system of higher education. From a

theoretical perspective, his descriptions of the characteristics of good indicators

paralleled those of other researchers (Meadows, 1998; Cohen, 2007, Lee &

Buckthorp, 2008).

Multiple uses of indicators. Researchers in the American system of

higher education, Cabrera, Colbeck, and Terenzini (2001) noted that traditionally

accepted indicators of institutional success, such as financial resources and

academic reputation, began to be questioned in the 1990s. They noted that

performance indicators began to play a more important role in public policy. In

particular, performance indicators should: (a) inform the institution about some

institutional value; (b) be used in groups rather than singly so as to give a

comprehensive picture of the subject being examined; and (c) provide information

about the processes and inputs of a particular academic function.

Zarkesh and Beas (2004) went further to link performance indicators

specifically to community college funding. In 2003, nine states (Florida, Missouri,

Ohio, Oklahoma, North Carolina, South Carolina, Texas, Tennessee, and

Wyoming) used performance indicators to determine at least part of the state

funding formula for community colleges. Conducting their own survey, the two

researchers found that community colleges used 16 different indicators both for

securing additional funding and for program assessment. Because this work was

conducted in 2003, well before the Great Recession, it may no longer be timely or

relevant to a different economic condition. That alone provides reason to follow

up on ways of using performance indicators in community college funding and

policy-making.

   Synthesis. Institutions of higher education are large, complex systems. In

order to understand the ways in which institutions are successful (or ways in which

they can be more successful), different indicators can be used as a form of proxy

measurement (Hassan, 2008).

   The development of useful indicators is a complex process involving both

quantitative and qualitative measures. Some characteristics were identified

repeatedly by multiple authors. It is assumed that this overlap set of identified

characteristics equates to the most relevant ones. These characteristics of good

indicators included: (a) they have been developed in a democratic, participatory

manner; (b) they respond to clearly stated questions, yielding easily understood

information; (c) they are stable, reliable, and valid, and they are not easily swayed

by individual data points; and (d) they do not lead to unintended consequences or

misuse of the data. The authors referenced herein did offer some additional characteristics, such as "feasible" and "hierarchical," but it is assumed that the most relevant characteristics were those on which the authors agreed.

Developing good indicators for assessing student success is important to community college success. Because of the link between education assessment, public policy, and funding formulas, community colleges need more ways to describe how their students are successful. The next section describes the use of graduation rate as a primary indicator of success and how student characteristics can affect it.

Theme 2: Student Characteristics Affect Graduation Rate

This section describes student characteristics that affect graduation rates. If understanding the characteristics of good indicators was foundational to the present examination, understanding student characteristics is the first floor built upon that foundation.

One of the important characteristics involves student persistence. Tinto's (1993) theoretical framework largely forms the foundation of literature related to student persistence and non-completion. He recognized that there are both personal and institutional factors that affect student persistence and completion. These factors are defined below.

Definitions. Tinto (1993) identified two entirely personal factors related to student persistence: intention and commitment. He defined *intention* as the motivating force for undertaking a degree program. He defined *commitment* as an

individual factor central to a student's decision to stay in higher education or to depart. Students may express their feelings about commitments as motivations, drives, or efforts to address non-academic responsibilities.

Tinto (1993) identified four additional factors related to student persistence: adjustment, difficulty, incongruence, and isolation. While he labeled them as institutional factors, they all have clear links to students' personal experiences. He defined *adjustment* as a student's ability to adjust socially and emotionally to an academic environment. He defined *difficulty* as meeting minimum standards in academic performance, and he noted that not all students are able to meet the minimums. He defined *incongruence* as a mismatch between the individual and the institution. Finally, he defined *isolation* as the lack of sufficient contact between the student and other members of the social and academic community.

Personal factors. Relying on Tinto's (1993) theory as a foundation, a number of researchers have conducted studies testing aspects of that theory. Students arrive in higher education with unique histories and personal factors, and these shape how they approach the college experience. These factors affect student success, and yet they are outside the control of the institution.

Astin (1997, 2004, 2005) has written prolifically on the subject. Since the passage of the federal *Student Right-to-Know and Campus Security Act of 1990*, the government has been collecting and publishing data on college graduation

rates. The assumption has been that these data will be useful to consumers of higher education as they look for an institution to attend. The implication has been that the higher the institution's graduation rate, the better the institution is performing at educating its students. According to Astin (2005), this can lead students to believe that their chance of successfully graduating from an institution is directly related to that institution's graduation rate.

Incoming students and engagement. In his research, Astin (1997, 2005) attempted to make sense of graduation rates. Conducting a national longitudinal study of 52,898 entering freshman at 365 baccalaureate-granting institutions (1997), he reached two conclusions: (a) the graduation rate was primarily a reflection of the entering freshmen's characteristics; and (b) differences in graduation rates were primarily attributable to differences in the composition of the student bodies. Later, he determined that 70% of variation among institutional graduation rates was attributable to different characteristics of the student body (2005).

Astin (2005) went further and applied this to the interpretation of other assessment data. He suggested that it may not be possible to know whether a low level of student engagement, for example, is a reflection of lack of effort on the institution's part or another characteristic common to the student body.

This issue bears significantly on community college research. Given that much of the existing research has been conducted in four-year institutions, and

given that the characteristics of community college students differ from those of students at four-year institutions (Sorey & Duggan, 2008), it follows that community college graduation rates may differ in unexpected or unknown ways from four-year institutions' graduation rates. Some of these differences will be described in the following paragraphs.

Traditional age students versus non-traditional age students. A natural progression in the literature review leads to the work of Sorey and Duggan (2008). They studied predictors of persistence between traditional-age and non-traditional age community college students. They found that community college students are typically older, more likely to be members of non-majority racial or ethnic groups, more likely to be first-generation college students, more likely to be from low-income families, and more likely to be academically underprepared for college-level work.

The authors studied students at a large, multi-campus community college. Data were drawn from the college's Office of Institutional Effectiveness, as well as from a survey administered to two samples of students. Response rate was 17.6%. The data suggested that the strength of predictors of persistence differed for traditional-age students and non-traditional age students. The strongest predictors for traditional-age students included encouragement and support and academic integration. The strongest predictors for non-traditional age students were social integration and institutional commitment (i.e., the student's

commitment to the institution). Other predictors affecting both groups, albeit differently, included: (a) degree utility, (b) fall/first term grade point average (GPA), (c) finances, and (d) intent to leave (p. 89-91).

The authors noted that the low response rate was a limitation of the study. While this study was conducted among community college students, it was only conducted on students at one institution, and it was conducted as a cross-sectional study rather than a longitudinal study. These limitations further support the need for more examination of indicators that can be used as predictors of success for community college students.

Geographical, racial, and language characteristics. Looking at student characteristics in a slightly different way, Adelman (2004) published a study examining a time-lapse set of three cohorts of students: the high school classes of 1972, 1982, and 1992. He looked at variables including sex, geography/geographical mobility, race/ethnicity, and second-language background. There were no unexplained differences among the cohorts.

His examination of the data yielded answers to two important questions: (a) What percentage of people in the cohorts earn a certificate or associates degree? (on average across all three cohorts: 15.5%); and (b) Does this differ between men and women? (on average across all three cohorts: men = 13.97%; women = 18.67%).

Adelman (2004) looked at other student characteristics. For example,

students in later cohorts were more geographically mobile, meaning that more of them were likely to attend multiple institutions. Additionally, white students saw significant gains in access to higher education from 1972 to 1982 and from 1982 to 1992; African-American and Latino students saw significant gains only between 1982 and 1992. Students from second-language backgrounds showed no statistically significant variation in attainment of a bachelor's degree whether they started in a community college or a four-year institution; native speakers of English, however, showed a consistent and statistically significant spread between those starting in a community college (approximately 39% earned a bachelor's degree) and those starting in a four-year institution (53%-56% earned a bachelor's degree).

Adelman's (2004) study was limited to students entering four-year institutions; collection of community college data was interesting, although merely incidental. This sample, then, ignored a large portion of the population that specifically intended to attend community colleges. It is worth re-examining the same or similar cohorts to determine whether those findings apply equally to community college students more generally.

Further, although the report was published in 2004, the data were collected between 1972 and 2000. The cohorts studied were from 1972, 1982, and 1992. The oldest data collected are now 44 years old; the most recent data collected are 24 years old. These spans could allow at least one generational shift between the

past and the present. It is worth conducting this study again with more recent data to determine whether previous patterns have stayed the same or changed.

Students purposely extending time until graduation. Volkwein and Lorang (1996) have researched characteristics of "extenders:" students who purposely take a lighter credit load and graduate in more than four years. They began by analyzing transcripts to construct a cohort. They examined juniors and seniors who had previously entered as first-time, full-time students. The variables they studied were academic integration, social integration, encouragement, finances, and goal commitment. The chief characteristic of students taking longer than expected to graduate was that they took fewer than 15 credits in a semester. The data suggested that there were two main factors in students taking longer than four years to graduate with a bachelor's degree: "(a) they wanted more time to enjoy life and to protect a high GPA; and (b) they needed more time for work and family responsibilities" (p. 63). The authors recommended further research: (a) a multi-institutional study to determine generalizability of their findings; and (b) a study of students admitted under special admissions programs (for example, TRIO programs designed to identify and provide supplemental services for disadvantaged students) (U.S. Department of Education, 2016b).

Like the previous studies discussed above, this study focused entirely on baccalaureate-seeking students and included community college students only incidentally. The study was limited to a single research institution offering

bachelor's degrees, master's degrees, and doctorates. Specifically, only transcripts from students achieving the status of junior or senior were examined. The transcript analysis portion of this study provided a foundation for methods that could be used in a study applied to the community college population.

Full-time or part-time attendance. King (2003) primarily looked at students' college choices from a financial perspective. She identified factors affecting the financial choices students make when selecting a college to attend: (a) institutional type, (b) institutional price, (c) attendance status, (d) living arrangement, (e) student budget, (f) grants, (g) net price, (h) student loans, (i) unmet need, and (j) employment. How students balance these choices may seem logical at the time, but they are often not in the students' best interest.

For example, students who elect to work more than 15 hours per week are less likely to persist until graduation. It may seem as through working, attending school part-time, and not borrowing money to go to college is a good way to avoid student debt. In this case, though, students are less likely to graduate. They pay a price in opportunity cost: those who are not college-educated have lower lifetime earnings. Those who borrow money to attend full-time and work only a small amount (or not at all) are much more likely to graduate. Although she discusses in greater detail how the weight of the various factors in various combinations can influence the students' outcomes, the full-time versus part-time attendance is one of the strongest of all the factors.

Synthesis. The authors identified above have described a number of personal student characteristics that affect graduation rate. These factors are either completely outside the direct control of institutions (e.g., students' personal histories, age, ethnicity, native language, etc.) or partially outside the direct control of institutions (e.g., students' engagement with the college, ability to adjust to a new environment, incentive to move through programs at a particular pace, etc.). This calls into question how good graduation rate is as an indicator of institutional success if it can be heavily influenced by outside factors affecting students.

In previous studies, researchers have left open additional areas for research. Most of the studies referenced herein were conducted at four-year institutions; community college data were only collected and/or reported incidentally. Further, much of the research was conducted over 10 years ago. It is reasonable to question whether the changed economic environment since the Great Recession has had an impact on student characteristics.

Theme 3: Institutional Characteristics Affect Graduation Rate

Tinto (1993) identified two types of characteristics that affect student success: student characteristics and institutional characteristics. It is now time to turn to institutional characteristics that bear upon student success.

Type of school, selectivity, and income. Horn and Carroll (2006) have conducted research about the impact of institutional characteristics and student demographics on graduation rates. They looked at three variables: (a) Carnegie Classification, as an indicator of the institution's mission; (b) selectivity; and (c)

the size of low-income first-year population. The data showed that the most selective institutions had the highest graduation rates (75%), while minimally selective institutions had the lowest graduation rates (36%-39%).

Further examination of the data showed interesting findings. One finding was that women had a 6% higher graduation rate than men. Another finding was that an increase in low-income students tended to lower the average graduation rate overall. Still another finding was that White and Asian students tended to graduate in higher percentages than Black or Hispanic students, with an average gap of 18%.

Horn and Carroll (2006) made an important distinction between graduation rates and completion rates. Whereas graduation rates measure cohorts of first-time, full-time students, completion rates include transfer students. When including transfer students in the completion measure, the overall rate rose by seven points from 58% to 65%.

Like Adelman's study (2004), this study was also limited by its focus on baccalaureate-seeking students. Nonetheless, this study demonstrated that institutional selectivity impacts graduation rate: the greater the selectivity, the higher the graduation rate. This has direct bearing on community colleges, which have open access policies that accept all applicants. From this research, one might reasonably intuit that graduation rates are "stacked against" community colleges.

Articulation agreements and degree partnerships. Garcia-Falconetti (2009) examined Florida's statewide articulation agreement as it related to community college student persistence and success. The author constructed a sample of 2,612 community college students. She identified six factors that represented academic success: (a) number of breaks in continuous enrollment, (b) change in major, (c) cumulative semester hours completed, (d) final grade point average, (e) number of 1000 and 2000 level hours completed, and (f) total semesters enrolled. The data suggested that one of the primary factors associated with academic success and persistence was the number of first- and second-year level credit hours completed.

The primary limitation of this study was that it was conducted only in Florida, which has a statewide articulation agreement among all institutions of higher education. Because of the ease with which students can transfer among institutions, it might be expected that they accumulate a greater number of credits. It may be worth testing this hypothesis in a future study.

In Oregon, Russ-Eft, Hindman, and Clemetsen (2016) examined baccalaureate completion rates among students who participated in a degree partnership program between a community college and a land-grant university. They tested three hypotheses looking at baccalaureate degree completion rates; grade point averages and number of credits to completion; and underserved populations participating in a degree partnership program. They found that there

were statistically significant differences in degree completion rates between those students who participated in such a program (68% graduated within eight years) and students who did not participate in such a program (63% graduated in eight-and-a-quarter years). Using a logistic regression analysis, they found that students who participated in a degree partnership program were 1.23 times more likely to complete their baccalaureate degree. Looking at a subset of non-traditional age students, they found that these students were even more likely (2.13 times more likely) to complete their degree.

The chief limitation in their research is that it focused on students intentionally starting out in a community college with the express purpose of earning a baccalaureate degree. It did not consider students whose intention was to earn a sub-baccalaureate degree or certificate. It may be useful to conduct similar research about community college students who do not intend to seek a baccalaureate degree.

Synthesis. The authors identified above have described a number of institutional factors that affect students' ability to graduate. These factors are either completely or partially outside the control of students (e.g., type of school, selectivity, articulation agreements, size of the low-income population, etc.). This calls into question whether graduation rate is a good indicator of student success.

In previous studies, researchers have left open additional areas for research. Most of the studies referenced herein were conducted at four-year institutions;

community college data were only collected and/or reported incidentally. When community colleges were intentionally examined, it was in the context of transferring to a four-year institution to earn a baccalaureate degree.

While some measures have been tested against community college populations, few have been tested purposefully, and none have been tested longitudinally over a 10-year period. Given these gaps in the literature, there is a need for studies that will advance the scholarly conversation about useful indicators to measure student success, and therefore community college success by proxy.

Theme 4: Success Ratio, DWI Index, Course Completion Ratio, and Successful Learning Rate (SLR)

Since 1988 there have been several attempts to define a predictive indicator of student success based on credit-by-credit or course-by-course performance. This section examines four iterations in the evolution of such an indicator. These evolutionary steps culminate in the need for research about a specific indicator of success: the Successful Learning Rate or SLR.

Definitions. The following paragraphs will define the measures in the literature that were related to the SLR. Additionally, literature specific to each measure's creation or first use will be discussed. Critiques of specific studies will appear in subsequent sections.

Success ratio. The first mention of the *Success Ratio* in the scholarly literature appeared in a 1988 study of chemistry students at Burlington County College in New Jersey (Sollimo, 1988). The author operationalized it as:

$$Success\ Ratio\ = \frac{Number\ of\ credits\ successfully\ completed}{Number\ of\ credits\ attempted}$$

The conclusion of this study suggested that the Success Ratio was one of four useful factors in advising students to take a general college chemistry course (i.e., Chemistry 105 versus a pre-college chemistry course). The other useful factors were a better-than-average GPA, a course equivalent to (or better than) intermediate algebra, and a recent pre-college course in chemistry with a minimum grade of B.

DWI index. The next mention of a similar indicator was made by Adelman (1999). He called it the *DWI Index* (DWI: drops/withdrawals/incompletes), and he took an inverse view of it vis-à-vis the Success Ratio. He operationalized it as:

$$DWI\ Index\ = \frac{Course\ Drops/Withdrawals/Incompletes}{Number\ of\ courses\ attempted}$$

His research found that the higher the DWI, there was a more strongly negative correlation with eventual graduation. That is to say, students who dropped/withdrew/or left courses incomplete were less likely ever to graduate. He felt that the DWI Index was a strong indicator because it was more reliable than what students self-reported after the fact in surveys or interviews.

Course completion ratio. The next mention of a similar indicator was suggested by Hagedorn (2005a). Called the *Course Completion Ratio*, she operationalized it as:

$$Course\ Completion\ Ratio\ = \frac{Number\ of\ courses\ completed\ with\ grades\ A, B, C, or\ P}{Number\ of\ courses\ of\ enrollment}$$

Hagedorn, in her own research (2005a, b) and in collaboration with others (Hagedorn, Chi, Cepeda, & McLain, 2007; Hagedorn & Kress, 2008; Hagedorn, Maxwell, Cypers, Moon, & Lester, 2007; Hagedorn, Moon, Cypers, Maxwell, & Lester, 2006), proposed that the Course Completion Ratio:

> …[Is] especially suited to community college students because they use the student's expressed behavior, enrolling for a course, as the basis for appraising achievement. While it can be argued that many students do not intend to transfer or earn a degree or certificate, it is likely that students who enroll for a course and remain in it through at least four weeks have the intention of finishing the course. Although it is an uncomplicated measure, the course completion ratio is a robust measure of success with a more sensitive range of variation beyond that of the usual dichotomous measure of retention used in many studies. Further, the course completion ratio is an appropriate measure for the community college environment because it flexes to accommodate part-time enrollment that is prevalent among community college students (p. 472).

Successful learning rate. The next iteration of this indicator was proposed by Rice (2008, 2010; Rice & Russell, 2012). Called the Successful Learning Rate (SLR), it was a part of a larger model for measuring student success: the Student Learning Progress Model. Rice operationalized it as:

$$Successful\ Learning\ Rate\ = \frac{Number\ of\ courses\ successfully\ completed\ with\ a\ passing\ grade}{Total\ courses\ attempted}$$

Although this indicator has been piloted at the University of Alaska-Anchorage and at Mt. Hood Community College, it has not been formally examined by statistical means (Rice, Fair-Szofran, & Franks, 2010). So far, it has been used as a descriptive indicator of student success. The literature is wide open for studies examining the SLR.

Studies using these indicators. The previous section defined the indicators and discussed their creation and first use. The following sections will examine and critique studies using these indicators.

Studies using the Success Ratio. The literature reports only a single study using the Success Ratio. Sollimo (1988) conducted his research very specifically on chemistry students at a community college. While the research was conducted at a community college, it was limited in its scope to a particular group of students, and it focused on the credits earned, not the number of courses passed. This narrow focus leaves room for further research looking more broadly at community college students in general and on other potentially useful indicators.

Studies using the DWI Index. The literature reports only studies by Adelman (1999, 2004), who first suggested the DWI Index (later renamed the WPRT Ratio: non-credit withdrawal and no-credit repeat) (Adelman, 2006). In contrast to Sollimo (1988), Adelman (1999) focused on courses rather than credits.

Nonetheless, Adelman left additional areas for further research: (a) he focused on courses dropped, withdrawn, or incomplete, not on courses passed; and (b) he focused primarily on baccalaureate-seeking students; community college students were included only incidentally, and they were not a focus of the research.

   Studies using the Course Completion Ratio. Hagedorn (2005a, 2005b, 2012; Hagedorn & Kress, 2008) focused on both courses and community college students. She herself noted that there was further research to be conducted. She posited that future research in this area would provide powerful information about students and their progress through higher education.

   Other studies have made use of the Course Completion Ratio, although not as the primary focus of research. Hagedorn, Chi, Cepeda, and McLain (2007) looked at it incidentally while examining the role of *critical mass* in a community college Latino population, i.e., the relationship between the level of representation and academic success. They found a significant correlation between a greater number of Latino students and a higher Course Completion Ratio for such students; thus, the focus of the research was on the level of critical mass needed to have any kind of positive impact on Latino students specifically.

   Razfar and Simon (2011) examined Latino ESL students and the gatekeeping function of credit and non-credit ESL courses. Using transcript analysis for the quantitative portion of their study, Razfar and Simon found a significant relationship between ESL mainstreaming (moving into English-only

instruction) and a higher Course Completion Ratio. As in the Hagedorn, Chi,

Cepeda, and McLain (2007) study, this finding was incidental to the original

research question.

Hagedorn, Maxwell, Cypers, Moon, and Lester (2007) examined the issue

of course shopping among community college students.

> Course shopping is defined as the dropping and adding of courses
> within the add/drop time period allowed by the college. Shopping
> differs from course dropping, another common student phenomenon,
> because to fit the definition, a course drop must be accompanied by
> the addition of another course in its place. We have defined and
> focused on two main types of course shipping behaviors herein
> labeled cyclic shopping (the pattern of dropping a course and adding
> another in its place) and bulk shopping (signing up for more courses
> than the student expects to complete with the expectation of dropping
> some later). (p. 465)

One of their primary research questions was whether students who course shop

had significantly different Course Completion Ratios from students who did not

course shop. They found that students who did not course shop had higher course

completion ratios than students who shopped for courses occasionally or

frequently.

Napier (2011) conducted a study testing a hypothetical model to determine

the best predictors of graduation and best predictors of the final grade point

averages of graduate students in social work. Napier operationalized the Course

Completion Ratio as:

$$Course\ Completion\ Ratio\ = \frac{Number\ of\ courses\ successfully\ completed\ in\ a\ semster}{Total\ courses\ attempted\ in\ a\ semester}$$

She limited the ratio to a per-semester measure, although it was not clear why she did so. The course completion ratio was only one of many predictors she examined. She found that the Course Completion Ratio was one of the best predictors of graduation and of final GPA.

Napier's study was limited in that it looked only at graduate students in a social work program at a single research university. She acknowledged that her findings may not be generalizable to other schools of social work. For the purposes of the present review, her findings were limited by the program, the graduate level, and the type of institution. Although she examined the Course Completion Ratio as a predictor of graduation, Napier's study leaves room for further research on different populations in different educational environments.

Studies using the Successful Learning Rate. There are no published studies using or even examining the SLR. Rice (2008, 2010; Rice & Russell, 2012) collaboratively developed the Student Learning Progress Model (of which the SLR is one aspect) with the faculty at the University of Alaska-Anchorage. Rice introduced the model at the national conference of the Association for Institutional Research in 2008, and he presented on it at the Pacific Northwest Association for Institutional Research and Planning conference in 2010 (Rice, Fair-Szofran, & Franks, 2010). Although a beta test was started at Mt. Hood Community College, a change in the top administration of the college and a reorganization of the Institutional Research & Planning department led that test

nowhere. No findings were published, and no records remained available at Mt. Hood Community College after the departure of staff involved.

Summary of the Literature Review

In reviewing the literature, four broad themes emerged related to graduation rates as an indicator of institutional success. These themes were identified consistently in the literature, and it is assumed that they will be important areas of focus for further research. These themes are: (a) the characteristics of good indicators; (b) the way in which student characteristics affect graduation rates as an indicator of success; (c) the way in which institutional characteristics affect graduation rates as an indicator of success; and (d) the evolution of the particular indicator to be examined in the present study.

Good indicators share at least these characteristics: (a) they have been developed in a democratic, participatory manner; (b) they respond to clearly stated questions, yielding easily understood information; (c) they are stable, reliable, and valid, and they are not easily swayed by individual data points; and (d) they do not lead to unintended consequences or misuse of the data.

Student characteristics that powerfully impact graduation rates include: race, language, age, and income. These are personal factors outside of the control of the institution: they were not assigned to students in a democratic, participatory manner; they are not nuanced factors that respond well to clearly stated questions; and they can certainly lead to unintended consequences when considered. Nor are these factors actually about the institution itself; these are factors that affect the

students of the institution. As an indicator of success, graduation rate is impacted

by all of the factors listed above. Graduation rates, therefore, do not adhere to the

characteristics of good indicators.

Institutional factors that impact graduation rates include: engagement, type

of school, selectivity, and articulation agreements. Institutions of higher education

have some control over these factors, but they are outside of the control of

students. For example, selectivity is never about democratic participation; it is

always about the exclusion of some students. The more selective an institution is,

the more students it excludes. This reason alone taints the graduation rate by

allowing institutions to cherry-pick the most promising students and to exclude

those who may be less likely to succeed. Again, graduation rates do not adhere to

the characteristics of good indicators.

One measure that may be a better indicator has evolved over the past two

decades. It began life as the Success Ratio. It spawned a related indicator called

the DWI Index. Finally, it morphed into the twin measures Course Completion

Ratio and SLR. The SLR is a simple, flexible indicator of student success, which

may be used as a proxy for institutional success.

Graduation rates do not meet all of the characteristics of good indicators.

They have not been developed in a democratic, participatory manner: they have

been dictated by the U.S. Department of Education. They do not respond to

clearly stated questions or yield easily understood information: graduation is only

one goal of community college students, and graduation rate does not address students' other goals. Graduation rates may be stable and reliable, although they are not necessarily valid: they do not measure what they are supposed to measure, namely student success. In the case of community colleges, graduation rates certainly do lead to unintended consequences, if not the outright misuse of data. Unfortunately, graduation rate as an indicator of institutional success is not going away.

The SLR, on the other hand, adheres to the characteristics of a good indicator. It lacks published studies, particularly as applied to community colleges. It also lacks statistical analysis to support it as either a reliable, valid indicator or as a potential predictor of eventual graduation. These gaps require research to support or refute the use of the Successful Learning Rate as a good indicator of success.

Implications for further research. There are several types of studies needed to expand on the existing research. Napier (2011) suggested that future research about predictive models for student success be conducted at other graduate programs of social work to test for generalizability. It follows that similar research could (and perhaps should) be applied to graduate programs in other disciplines, bachelor-level programs in any discipline, and associate-level programs in any discipline.

Hagedorn and her co-researchers (Hagedorn, 2005b; Hagedorn, Cabrera, &

Prather, 2011; Hagedorn, Chi, Cepeda, & McLain, 2007; Hagedorn & Kress,

2008) suggested several areas for further research. Focusing specifically on

community college populations, they suggested using the Course Completion

Ratio as one variable in multivariate analysis with other factors: remedial math

courses, remedial English courses, ESL courses, financial aid, student age, student

gender, student ethnicity, employment status, part-time student status, full-time

student status, part-time faculty status, full-time faculty status, and other factors.

Such an analysis would identify the factors related to course completion and,

potentially, to student success.

Foundational to all of these avenues of research is the question whether the

Course Completion Ratio or the SLR or some other measure is a powerful enough

indicator of student success to stand on its own. It has been shown to have value

as one variable in predictive models of student success, but to what extent can it

serve as a predictor of student success in its own right? This research examined

that question.

Implications for practice. At the least, Hagedorn and her co-researchers

(Hagedorn, Chi, Cepeda, & McLain, 2007; Hagedorn & Kress, 2008; Hagedorn,

Moon, Cypers, Maxwell, & Lester, 2006) suggested specifically that community

colleges should mine their own available transcript data for two reasons: (a) to

build a culture of evidence based on data, and (b) to harness the power of the data

that is specific to local communities, not broad datasets that may or may not be

generalizable to local situations. Further, they posited that a new definition of student success might be developed by combining multiple established measures.

At its core, such research has policy implications for community colleges. Understanding the various routes students take to achieving success can lead to new support frameworks, putting in place or realigning existing academic structures to better support students at critical points of need. New ways of understanding student success can influence financial support for students who have goals other than traditional graduation. New ways of defining student success can help community colleges tell their stories more effectively, gaining new students and greater community support for the broad work that they do.

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Chapter 3 / Manuscript #2:
Successful Learning Rate as a Predictor of Student Success

Jeffery R. Ring and Darlene F. Russ-Eft

Abstract

This paper describes one method for studying the Successful Learning Rate as an indicator of student success. These research questions guided the selection and development of the method: (a) To what extent does the Successful Learning Rate correlate with eventual graduation within 150% of the normal time to completion? (b) To what extent does the Successful Learning Rate vary in relation to student characteristics? (c) In what ways does a correlation between the Successful Learning Rate and Graduation Rate suggest changing the definition of "normal time to completion" and the existing 150% threshold?

The data examined came from an extant data set, from which all personally identifiable information has been removed. Correlations were examined between SLR and eventual graduation. Relationships among the variables studied were examined by logistic regression. The correlation between the SLR and graduation was very slight at $r = 0.082$. The SLR did vary significantly according to student attendance (full-time or part-time) and student age (traditional age or non-traditional age), all of which were statistically significant ($p < .001$) predictors among students who do graduate. Although the correlation was not strong enough to suggest changing the definition of normal time to completion or the existing 150% threshold, further research is suggested into the relationships among SLR, non-traditional student age, and graduation.

Keywords: Successful Learning Rate, predictive correlational study

Successful Learning Rate as a Predictor of Student Success

When the *Student Right-To-Know and Campus Security Act of 1990* was
implemented, all institutions of higher education were required to provide
graduation rates of first-time, full-time, degree-seeking students who completed a
degree program within 150% of the "normal time to completion" (e.g., a program
that can be completed in two years of full-time study can only count graduates
who complete in no longer than three years) (U.S. Department of Education, 2016).
The implication is that institutions with higher graduation rates are more
successful than those with lower graduation rates (Astin, 2005).

Given the volume of research into the links among student characteristics,
institutional characteristics, and graduation rates (Hagedorn, 2005; Horn & Carroll,
2006; O'Conor, 2009; Sorey & Duggan, 2008; Tinto, 1988, 1993; Volkwein &
Lorang, 1996; Yorke, 1999), it is reasonable to question whether graduation rate is
a reliable indicator of either student success or institutional success, particularly
when applied to community colleges (Burd, 2004; Hagedorn, 2005; Muhndenk,
2000; Rice & Russell, 2012). Students attending community colleges may not
intend to graduate with a degree. They may attend with completely different goals
in mind: taking a few courses to try out the college experience, taking a few
courses to get a promotion at work, taking a few courses to update skills to change
jobs, taking a few courses to improve their home lives, etc. While these students
may have achieved their personal goals, they are not counted as successful

according to current US Department of Education standards (Bailey, Calcagno,

Jenkins, Leinbach, & Kienzl, 2006; Hagedorn, 2005; US Department of Education,

2013). Thus, it is important to consider some alternatives to graduation rate.

Literature Review

This study is an examination of a proposed indicator of student success,

also to serve as a proxy for institutional success. The Student Learning Progress

Model (SLPM) has been proposed as a new way of reporting student success. At

its heart is the Successful Learning Rate (SLR), the ratio of classes passed to

classes attempted. The SLPM is a descriptive model, designed to "tell the story"

of student success; the SLR is the chief input to the model. The SLPM was beta

tested in two community colleges: Mt. Hood Community College (MHCC) in

Gresham, Oregon, and Houston Community College in Houston, Texas. The SLR

has not previously been examined quantitatively to determine whether it correlates

with eventual graduation.

In reviewing the literature, four themes emerged: (a) review the

characteristics of good indicators; (b) review the student characteristics affecting

graduation rate; (c) review the institutional characteristics affecting graduation

rate; and (d) review related indicators for similarities and differences. These

themes are discussed in the following subsections.

Characteristics of good indicators. Meadows (1998) defined indicators

as abstractions of larger models, and models as abstractions of complex systems.

Indicators describe, though never perfectly, the functioning of a system. She

described indicators as either objective or subjective, preferring the qualitative feel of subjective indicators, although she acknowledged that quantitative indicators were more likely to be verifiable. She acknowledged that all indicators are in some ways subjective, as they reflect value judgments about what is important to measure. She posited 15 characteristics of good indicators. They are: (a) clear in value, (b) clear in content and easily understood, (c) compelling, (d) policy relevant, (e) feasible, (f) sufficient, (g) timely, (h) appropriate in scale, (i) democratic, (j) supplementary, (k) participatory, (l) hierarchical, (m) physical, (n) leading, and (o) tentative (pp. 17-18).

Cohen (2007) took this work further. He defined three more characteristics of indicators: (a) they should be based on systems thinking; (b) they should be academically and practically grounded; and (c) they should be ethically motivated. Although he did not attempt to apply these characteristics practically, the theoretical definitions largely align with those of Meadows (1998).

Lee and Buckthorpe (2008) proposed four characteristics to determine how useful indicators might be: (a) they are calculated based on recent data and they can display annual trends; (b) they can be calculated for any full- or part-time program of study; (c) they are stable enough so that single data points do not have a disproportionate effect; and (d) they are calculated transparently to give an honest picture of student success. Although their research was conducted in the British system of higher education, their descriptions of characteristics of good

indicators would seem to apply to indicators used in the American system of higher education as well.

Yorke (1999) offered perhaps the most straightforward way to understand the characteristics of good indicators; he posed them as questions to be answered: (a) Who wants to know what? (b) What will the information be used for? (c) How valid and reliable are the indicators? and (d) Will using these indicators have any unintended side effects? Although not listed in the same way as his other indicators, he also noted that indicators should also be neutral across different types of institutions so as not to favor one type of institution over another.

Cabrera, Colbeck, and Terenzini (2001) and Zarkesh and Beas (2004) noted that performance indicators took on a more prominent role when linked to public policy and institutional funding. In this context, they stated that indicators should: (a) inform the institution about something of institutional value; (b) be used in groups to give a more complete assessment of the subject being examined; and (c) inform the institution about the workings of a specific academic unit.

Looking at the characteristics described above, areas of overlap become clear: (a) indicators need to be developed in a democratic, participatory manner; (b) indicators answer clearly stated questions and provide easily understood information; (c) indicators are both reliable and valid, not easily changed by single points of data; and (d) indicators do not lend themselves to misuse of the data (although all data is subject to misrepresentation) (Best, 2012; Huff, 1993).

Student characteristics affect graduation rate. In addition to the

characteristics of good indicators, there are other factors that affect graduation

rates. Student characteristics is one such factor.

Tinto (1993) developed a theoretical framework identifying factors that

impact student persistence and completion in higher education: intention and

commitment. *Intention* refers to students' motivating force for starting a degree

program. *Commitment* is the force that motivates students to stay the course. He

also identified four other characteristics that he calls institutional factors: (a)

adjustment, (b) difficulty, (c) incongruence, and (d) isolation. Although the

institution can have some impact on these factors, they are still linked to students'

personal experiences.

One researcher who has extensively examined aspects of Tinto's

theoretical framework is Astin (1997, 2004, 2005). In conducting a longitudinal

study of freshman entering baccalaureate programs (Astin, 1997), he found that

retention rates through graduation were primarily a reflection of students'

characteristics and that differences in graduation rates were a reflection of the

aggregate characteristics of students entering as a freshmen class. He fleshed that

out with further analyses that demonstrated that nearly 70% of variation among

institutions' graduation rates is attributable to differences in the characteristics of

the student body (Astin, 2005).

Others have examined student characteristics that appear to affect

graduation rate. For example, Sorey and Duggan (2008) looked at traditional age versus non-traditional age. They found that different characteristics affected the two groups differently. Predictors of graduation for traditional age students included encouragement, support, and academic integration. Predictors of graduation for non-traditional age students included social integration and the student's commitment to the institution.

Adelman (2004) looked at geographical mobility, race/ethnicity, second-language background, and gender through the lens of a longitudinal cohort study. Examining the data from different angles, he found that Caucasians had better access to higher education longer than African Americans or Latinos, although African Americans and Latinos began to show gains in access in the 1980s and 1990s. Among other interesting findings in the data, he discovered a difference between men and women who earn an associate's degree: 13.97% of men earned the degree while 18.67% of women earned the degree.

King (2003) looked at students' educational choices from a financial perspective: there are students who work and attend college part-time so that they do not incur debt, and there are students who borrow so that they can attend full-time. Although she looked at a number of factors (institutional price, grants, loans, net price, etc.), the question of full-time attendance versus part-time attendance was one of the strongest predictors of all: full-time attendance at school, while borrowing and working part-time, was clearly associated with student success.

Institutional characteristics affect graduation rate. Going into greater depth on characteristics that affect graduation rates, Tinto (1993) identified (a) adjustment, (b) difficulty, (c) incongruence, and (d) isolation as factors. He defined *adjustment* as students' ability to adjust to academic environments. *Difficulty* was about meeting at least the minimum standards of academic performance. *Incongruence* referred to a mismatch between the student and the institution. *Isolation* involved a lack of sufficient contact with other members of the social and academic community. Tinto considered these to be institutional characteristics. While students' personal histories impact these characteristics, they are also characteristics that institutions can at least partially address through student development interventions.

In addition to the characteristics identified by Tinto, other researchers suggested additional institutional characteristics that impact graduation rates. Horn and Carroll (2006) conducted research into the impact of type of institution, selectivity, and income of students and their families. Specifically, they examined the impact of: (a) Carnegie classification (interpreted to be an indicator of the institution's mission); (b) institutional selectivity; and (c) the size of the low-income freshman population. The most selective institutions had the highest graduation rates (75%), while the least selective institutions had the lowest graduation rates (36%-39%).

Another institutional characteristic impacting graduation rates is the

presence or absence of articulation agreements with other institutions. Garcia-Falconetti (2009) examined Florida's statewide articulation agreements among institutions of higher education. Florida is a rare case in the United States in having an integrated statewide system of public higher education. Because of this system, students can be tracked among public institutions of higher education. In this case, articulation agreements allowed for seamless transfer from community colleges to baccalaureate institutions. Interestingly, Garcia-Falconetti found that community college students who transferred to baccalaureate institutions dropped out at a statistically significant rate greater than students who started at baccalaureate institutions. While this was congruent with previous work by Cohen and Brawer (1982), it was an unexpected finding in this study.

Indicators related to the Successful Learning Rate. The literature reveals three indicators related to the SLR: (a) the Success Ratio; (b) the DWI Index; and (c) and the Course Completion Ratio. Developed by different researchers at different times, each indicator is an attempt to quantify something other than graduation rate to describe student success and to serve as a proxy for institutional success.

The Success Ratio was developed at Burlington County College in New Jersey in 1988 (Sollimo, 1988). It was developed as a means of advising students whether they should take a pre-college chemistry course or a college chemistry course. The author operationalized the Success Ratio as the number of credits

successfully completed to the number of credits attempted. It was determined that the Success Ratio was one of four useful factors for advising students about chemistry courses. While it was used at a community college, it was only applied very specifically to chemistry students. There were no other published studies of it being used or examined for any other purposes.

The DWI Index (Adelman, 1999, 2004) was an examination of the Drops, Withdrawals, and Incompletes of baccalaureate-seeking students. The DWI Index is the inverse of the SLR: it looks at courses *not* successfully completed. Adelman operationalized it as the number of course drops/withdrawals/incompletes to the number of courses attempted. He found it to have a strongly negative correlation with eventual graduation.

The Course Completion Ratio was developed by Hagedorn (2005) in a project to mine historical transcript data of community college students. She operationalized it as the number of courses completed with grades A, B, C, or P to the number of courses of enrollment. She believed it to be a robust measure because it flexes to accommodate community colleges and their prevalent part-time enrollment. Whereas the graduation rate is only calculated based on first-time, full-time students who enroll in a fall term, the Course Completion Ratio tracks all students' progress, regardless of full-time/part-time status or term of enrollment.

Synthesis and summary of the literature review. A review of the literature around indicators of student success, and therefore proxy indicators for institutional success, revealed four themes. These themes form the foundation for the present study.

First, there is the examination of what makes a good indicator: (a) indicators are developed in a participatory process; (b) they respond to clearly stated questions; (c) they are reliable and valid; and (d) they do not lead to misuse.

Second, there are student characteristics that affect graduation rates. These characteristics include: (a) intention, (b) commitment, (c) student engagement, and (d) student demographic characteristics (age, first language, race, income, gender). None of these characteristics can be impacted by institutional efforts.

Third, there are institutional characteristic that affect graduation rates. These characteristics include: (a) type of school, (b) selectivity, (c) composition of the student body (aggregate student demographic data), and (d) articulation agreements.

Fourth, there exist other indicators related to the SLR: (a) the Success Ratio, (b) the DWI Index, and (c) the Course Completion Ratio. The Success Ratio was applied to community college students, but it was very narrowly focused on chemistry students, and it was only applied as an advising tool. Further, its unit of measurement was the number of credits. The DWI Index measured course drops/withdrawals/incompletes of baccalaureate-seeking students. Its unit of

measurement was courses, but it looked at negative course outcomes, not positive ones. The Course Completion Ratio was applied to community college students broadly. It used the number of courses as its unit of measurement.

The present study fits neatly into the context of the literature. The SLR fits all of the criteria of good indicators: (a) it was developed in a participatory manner among faculty, institutional research staff, and administrators at the University of Alaska-Anchorage, and it was further beta tested at 18 institutions around the United States; (b) it answers questions about successful student learning, and it is an easily understood ratio of courses passed to courses attempted; (c) it is reliable and valid when applied to thousands or tens-of-thousands of students in an institution, and individual data points do not have a disproportionate effect; and (d) there is no obvious way to misuse the data (although all data is subject to misrepresentation) (Best, 2012; Huff, 1993).

It is known that both student characteristics and institutional characteristics affect graduation rates (Adelman, 2004; Astin, 2004, 2005; Sorey & Dugan, 2008; Tinto, 1993). It is unknown to what extent student characteristics might affect the SLR in the context of a community college population.

Related measures have generally not been tested against the full community college population, or they have only been tested against baccalaureate-granting institutions and baccalaureate-seeking students. In the case of the Course Completion Ratio, a virtual fraternal twin to the SLR, it has been

calculated incidentally for community college populations. No study has examined whether there is any relationship between the Course Completion Ratio (or the SLR) and eventual graduation. Although the literature talks around the need among community college for a better indicator than graduation rate, there has been no attempt to determine whether the SLR relates to graduation in any way. If it does, it may serve as a predictor of eventual graduation. This has immediate practical and political application: it can inform the discussion about success in higher education, and it can help institutions drill down into their existing data to find patterns and develop interventions to improve student success.

Type of Study

This study is a quasi-experimental predictive correlational study. The hypothesis examined is whether there is a correlation between the SLR and the graduation rate. If these types of data were to demonstrate a statistically significant association, it might be possible to determine the likelihood of eventual graduation based on a student's SLR.

SLR is a simple ratio of the number of courses successfully completed divided by the number of courses attempted.

$$Successful\ Learning\ Rate\ = \frac{Number\ of\ courses\ successfully\ completed\ with\ a\ passing\ grade}{Total\ courses\ attempted}$$

The unit of measure is the individual course, not a sequence of courses that lead to an award. The SLR provides ratio-level data.

Graduation rate, on the other hand, is the achievement of a degree earned within 150% of the period during which a full-time student would normally earn the degree (e.g., three years for a two-year degree). The unit of measure of graduation rate is therefore categorical: one either graduates or one does not. Because the SLR is an unbounded continuous variable, it may prove to be a more descriptive and precise measure than the dichotomous categorical variable of graduation.

Study Purpose and Research Questions

There are two types of questions addressed in longitudinal studies:

> The first question is descriptive and asks us to characterize each person's pattern of change over time. Is individual change linear? Nonlinear? Is it consistent over time or does it fluctuate? The second question is relational and asks us to examine the association between predictors and the patterns of change. Do different types of people experience different patterns of change? Which predictors are associated with which patterns? (Singer & Willett, 2003, p. 8)

The purpose of this study was to determine (a) whether there was a pattern of student success over time that correlated with eventual graduation, and (b) whether there were predictors that influenced such a correlation. If these things were true, it would provide another way to describe student success. Arguably, much research conducted in higher education today is qualitative in nature: it is about telling stories from students' and educators' perspectives. By contrast, this study was specifically designed to explore a quantitative structure that complements those stories with replicable data from a replicable model.

Under the Student Learning Progress Model (University of Alaska, 2016),

students experience success every time they complete a course with a passing grade; success is earned along the way, not just at the point of graduation. A specific SLR might correlate to a specific time-to-completion, which might in turn open conversations about the 150% threshold for counting graduations: is that the "right" threshold? Further, sorting students by individual characteristics (e.g., male versus female, full-time versus part-time, traditional-age versus non-traditional age, etc.) may show variations in the SLR that suggest early interventions in policies and practices to impact graduation. This study examined whether the SLR was a statistically significant measure in relation to eventual graduation, and it sought to determine whether there were statistically significant relationships between the SLR and other predictor variables.

The research questions examined in the study are:

1. To what extent does the SLR, measuring progress course-by-course, correlate with eventual graduation within 150% of the normal time to completion?

2. To what extent does the SLR vary in relation to student characteristics?

3. In what way does a correlation between the SLR and Graduation Rate suggest changing the definition of "normal time to completion" and the existing 150% threshold?

Key Steps of the Study's Design

Creswell (2008) identified six key steps in conducting a correlational

study: (a) determine if a correlational study best addresses the research problem; (b) identify individuals to study; (c) identify two or more measures for each individual in the study; (d) collect data and monitor potential threats; (e) analyze the data and represent the results; and (f) interpret the results.

This study sought to determine whether there is a relationship between variables, as well as the strength and form of such a relationship. This pointed toward the appropriateness of conducting a correlational study.

The data were analyzed using multiple techniques. Initially, descriptive statistical analysis suggested that there might be a relationship between the SLR and graduation rate. Correlational analysis was used to determine the nature, strength, and form of the relationship. Logistic regression was used to examine the relationship between graduation and the variables studied: (a) SLR, (b) gender, (c) student attendance (full-time or part-time), and (d) student age (traditional or non-traditional).

Institutional Review Concerns Regarding Human Subjects

Personally identifiable information was excluded from the data transfer. While the data included years of enrollment, numbers of courses attempted, numbers of courses successfully completed, gender, age, type of attendance, and graduation date (if applicable), no personally identifiable information was recorded or reported.

All transcripts examined were those of adults (18+ years of age). This research did not require participant consent, as the collection of transcript data is a

normal part of business in higher education.

The research methods described herein were reviewed by the Oregon State University's (OSU's) Institutional Review Board (IRB). OSU's IRB agreed to the Express Review process and concurred that there was no risk to human subjects. Approval to proceed was granted under the Exempt category.

Data Collected

Historical transcript data were examined in this study. The Institutional Research (IR) staff of the participating college extracted the data from the college's data warehouse. IR staff examined the data, and they corrected obvious errors and inconsistencies in data formats used by different information systems over the years. Finally, they sanitized it of any personally identifiable information, and they output it in multiple tables organized into enrollment data, student data, and graduation/certificate award data.

To protect the privacy of underage students, only transcripts from adult students (age 18+) were examined. Dual-credit high school students were also excluded regardless of age, as there was no clear indication that students earning college credit while in high school would continue at that particular community college (Calcagno, Crosta, Bailey, & Jenkins, 2007).

Data were organized into multiple data sets, with each set's records containing multiple fields of information. This allowed a descriptive analysis of multiple variables over time (Singer & Willett, 2003). Students' term-by-term progress was monitored for 40 terms (10 years) to reveal variations over time.

Data Preparation

As previously described, the data were collected from the participating college's record-keeping system by the college's Institutional Research staff. The data were conveyed to the researcher in the form of six data files and one text file describing the specifications of the other files.

The first four data files contained the same type of enrollment data divided into different periods: 2003-2006, 2007-2009, 2010-2012, and 2013-Current. The fifth data file contained student demographic data. The sixth data file contained academic credentials awarded.

All enrollment data were merged into a single enrollment file. After removing enrollment data that fell outside of the SLR's definitions (e.g., audits, community education courses), there remained 637,531 course enrollments to be examined. The student demographic data file was similarly cleaned: after removing records beyond the scope of this study (e.g., dual-enrolled high school students), there remained 51,115 student records to be examined. Finally, the degree and certificate award file was cleaned before being examined: after removing adult high school diplomas and GED awards, for example, there remained 10,467 degrees and certificates to be examined.

Finally, these three data tables were merged into a single master table. This table was arranged such that each student was a unique case (a single row), and the student's course enrollment, demographic, and award data were individual variables (each was a single column). This table was 51,115 rows in length,

representing the 51,115 students included in the study (for a full description of

data preparation, see Appendix B).

Data Analysis

Data records included discrete fields for each of the data elements defined

in Table 3.1. Descriptive statistics were reported about the data set as a whole and

as grouped subsets based on student characteristics. Table 3.2 provides an overall

description of the population examined ($N = 51,115$) broken down by gender,

attendance, age, and graduation status. The sample includes more men than

women, more part-time attendance than full-time attendance, more non-traditional

age students than traditional age students, and more non-graduates than graduates.

Table 3.3 breaks down the sample into greater detail. Sorted by gender,

this table shows a similar percentage of full-time and part-time students (full-time

females = 26.34% vs. full-time males = 25.31%; part-time females = 73.66% vs.

part-time males = 74.69%), as well as a similar percentage of traditional age and

non-traditional age students (traditional age females = 30.58% vs. traditional age

males = 31.96%; non-traditional age females = 69.42% vs. non-traditional age

males = 68.04%). This table shows a less similar comparison in graduation status

(all graduating females = 9.38% vs. all graduating males = 6.62%).

Table 3.4 displays the date rotated so that full-time attendance versus part-

time attendance forms the X-axis. Here, the split between full-time and part-time

traditional age students versus non-traditional age students becomes more obvious

(full-time traditional age students = 43.89% vs. full-time non-traditional students =

56.11%; part-time traditional age students = 26.31% vs. part-time non-traditional age students = 73.69%). There is a notable difference between graduates who attended full-time and graduates who attended part-time (15.84% vs. 4.80%).

Table 3.5 displays the data rotated once again so that traditional age versus non-traditional age forms the X-axis. Here, the arrangement of the data makes the traditional age/non-traditional age and full-time/part time split look even more pronounced (traditional age full-time students = 35.38% vs. traditional age part-time students = 64.62%; non-traditional age full-time students = 19.99% vs. non-traditional age part-time students = 80.01%). There is a small but noticeable gap between non-traditional age students who graduate on time and traditional age students who graduate on time (4.20% vs. 2.76%). This gap virtually disappears between traditional age students and non-traditional age students who graduate over time (3.86% vs. 3.73%), with traditional age graduates slightly ahead.

Table 3.6 rotates the data one final time so that graduation status forms the X-axis. This final rotation does not provide any unexpected insights into the data. Although the percentages appear on the surface to differ, they did not suggest any new relationships to explore.

Statistical tests. Statistical tests were applied to the aggregate data and to grouped subsets based on student characteristics: gender, age, attendance type, and graduation status. The size of the data set examined ($N = 51,115$) was sufficiently large that significance was set to $p < .001$ for all statistical tests. Power was

calculated post hoc and determined to be 100% for a correlation at or better than $p = 0.08$.

Although it would have been ideal to examine the entire population of students, the reality was that the aggregate data included some incomplete student records or records that were otherwise unsuitable for analysis (e.g., high school students dual-enrolled at a community college). While it may have been desirable to retrieve data describing the full population of students, it was not necessary for this study.

Bivariate statistics. The calculation of the Successful Learning Rate

$$Successful\ Learning\ Rate\ = \frac{Number\ of\ courses\ successfully\ completed\ with\ a\ passing\ grade}{Total\ courses\ attempted}$$

produces ratio-level data. The number of terms completed is ratio-level data. Probing for a correlation between Successful Learning Rate and number of terms completed involves two continuous variables. For this reason, Pearson's *r* was the statistical test of choice used to explore this relationship (Courtney, 2009; Creswell, 2008; Gall, Gall, & Borg, 2007).

As previously stated, the Successful Learning Rate produces ratio-level data. "Graduated" versus "non-graduated" is dichotomous data. Probing for a correlation between ratio-level data and dichotomous data involves continuous and non-continuous variables. For this reason, point-biserial correlation was the

statistical test of choice used to explore this relationship (Courtney, 2009; Creswell, 2008; Gall, Gall, & Borg, 2007).

Although the size of the sample was large, some variables within it were not normally distributed. For example, the SLR always reduces to a measure between 0 and 1. Most SLRs group between .7 and 1.0, clustering toward one end of the scale. These differing distributions necessitated both parametric and non-parametric approaches to data analysis. The varying tests and their results are discussed in the findings section following each research question.

Addressing the strength of correlations, Courtney (2009, p. 270) provided a useful scale that was employed in this study:

.00-.20	Slight, almost negligible relationship
.20-.40	Low correlation; definite but small relationship
.40-.70	Moderate correlation; substantial relationship
.70-.90	High correlation; marked relationship
.90-1.00	Very high correlation; very dependable relationship

Based on this scale, moderate or stronger correlations (.40+) were considered statistically interesting and warranted further research.

Multivariate statistics. Creswell (2008) relates the use of multiple regression analysis to correlational analysis: "Multiple regression (or multiple correlation) is a statistical procedure for examining the combined relationship of *multiple* independent variables with a single dependent variable" (p. 368). This type of statistical test is used to examine relationships among more than two variables.

Gall, Gall, and Borg (2007) provided more detail than Creswell. They recommended multiple regression analysis in general for this type of study, and they recommended logistic regression as the specific tool to examine this combination of variables. Garson (2012) further supported this recommendation, as logistic regression does not assume a linear relationship among the variables, does not require a normal distribution, and is generally a less strict analytical tool than other types of regression analysis.

This study examined the relationships among multiple variables: SLR, graduation status, gender, attendance type (full-time or part-time) and age (traditional or non-traditional). The SLR was treated as an independent predictor variable, and it provided ratio-level data. All the other variables examined in this study are categorical variables. Successful graduation is the dependent variable. As with bivariate statistics, normal and non-normal distributions required the use of differing statistical tests. Searching for any relationships that might be found among the variables, goodness-of-fit and pseudo-R^2 values were calculated. The model itself proved to be statistically reliable.

$\chi^2(5, N = 51,115) = 1260.41, p < .001$, Nagelkerke $R^2 = .375$.

Results

Findings and discussion are presented below in the context of each of the research questions examined in this study.

Research Question 1. To what extent does the Successful Learning Rate, measuring progress course-by-course, correlate with eventual graduation within 150% of the normal time to completion?

Findings. Using biserial correlation to test the relationship between the SLR and graduation within 150% of the normal time to completion resulted in a correlation coefficient of $r = 0.082$. According to Courtney's (2009) scale, the correlation coefficient indicates a slight, almost negligible relationship.

The Mann-Whitney U was selected because the SLR did not show a normal distribution: the SLR ranges from 0 to 1, but the mean was .89 ($SD = .26$). The Mann-Whitney U tested for differences in the mean SLR between students who graduated within the 150% window ($M = .99$, $SD = .04$) and those who graduated over the 150% window or who did not graduate at all ($M = .88$, $SD = .26$), $p < .001$. The mean SLR of students who graduated within 150% was significantly higher than the mean SLR of students who graduated over 150% or did not graduate (see Table 3.7).

Broadening the examination to students who graduated at any time during the 10-year examination period, the Mann-Whitney U test showed that the mean SLR of all students who graduated ($M = .98$, $SD = .05$) was significantly higher than the mean SLR of students who did not graduate ($M = .88$, $SD = .26$), $p < .001$ (see Table 3.7).

Discussion. Given the centrality of the SLR to the Student Learning Progress Model, it was unexpected to find such a slight correlation between the SLR and eventual graduation. Community colleges, whose highest award is typically the associate's degree, would normally count three years as the outer limit of the 150% window for successful graduation. The SLR looks at student progress for 10 years, opening that window to 500%. One might intuitively expect that more graduations would yield more data points, and that those additional data points might reveal a stronger, clearer correlation. There was a positive correlation, but only to a very slight extent.

As a new model that tracks students longer to better tell their stories of academic success, it was thought that the SLR might have had a stronger correlation with eventual graduation. Although a correlation exists, it is unimpressive. The SLR remains an interesting indicator, although perhaps not as quantitatively powerful as might have been hoped. Were there an official H_o stated up front, these findings would have barely refuted it.

Shifting attention to the mean SLRs of students who graduated versus students who did not graduate in the 150% window, it was unsurprising to find that the mean SLR of graduates was significantly higher than that of non-graduates or those who graduated beyond the 150% window. Likewise, it was unsurprising to find that the mean SLR of all graduates (both within and beyond the 150% window) was significantly higher than that of non-graduates. It makes intuitive

sense that all graduates would have a higher mean SLR than that of non-graduates: those who graduated passed more classes than those who did not. These findings at least lend quantitative support to that intuitive understanding.

Research Question 2. To what extent does the Successful Learning Rate vary in relation to student characteristics?

Findings. To examine student characteristics, the Mann-Whitney U test was used to test for differences in mean SLR based on student gender, student attendance (full-time or part-time), and student age (traditional or non-traditional). There were no significant differences based on gender, $p = .180$. In contrast, the mean SLR of part-time students ($M = .91$, $SD = .25$) was significantly higher than the mean SLR of full-time students ($M = .83$, $SD = .28$), $p < .001$. Further, the mean SLR of non-traditional age students ($M = .91$, $SD = .24$) was significantly higher than the mean SLR of traditional age students ($M = .83$, $SD = .29$), $p < .001$ (see Table 3.8).

Further, those students who graduated were examined in greater depth with logistic regression analysis. This was done to explore predictors about students graduating on time or over the 150% time limit and relationships among the variables (see Table 3.9).

Among the predictor variables, gender was not significant, $p = .307$. The SLR was a significant predictor, $OR = 1.065$, $p < .001$, 95% CI [1.045 1.086]. As a student's SLR increases, the more likely she is to graduate on time.

The number of terms enrolled, *OR* = .736, *p* < .001, 95% CI [.718 .753]

and the student's attendance type, *OR* = .370, *p* < .001, 95% CI [.317 .432] were

also significant predictors. The odds ratios showed that the fewer terms enrolled,

the more likely students are to graduate on time; and part-time students are less

likely to graduate on time than full-time students, confirming an intuitive and

common-sense understanding (see Table 3.9).

The student's age was a significant predictor,

OR = .809, *p* = .015, 95% CI [.682 .960] with traditional age students less likely to

graduate on time. The caveat with this statement is that the significance is

considerably lower than the level used for other variables in this study. It is

included here for two reasons: (a) it is significant when compared to a typical

significance level used in social science research: *p* < .05; and (b) it aligns with

other work showing that non-traditional age can be a significant factor in

graduation (Sorey & Duggan, 2008; Russ-Eft, Hindman, & Clemetsen, 2016).

Discussion. The mean SLR varied significantly for some student

characteristics and only slightly for others. It did not vary significantly based on

the student's gender, for example. On the other hand, the mean SLR did vary

significantly based on the student's attendance (full-time versus part-time) and age

(traditional versus non-traditional).

Looking further into attendance and age as possible predictors for eventual

graduation, logistic regression analysis was conducted against all students who

graduated. These characteristics – higher SLRs, number of terms enrolled, full-time attendance, and non-traditional age – all pointed to successful graduations. It is easy to understand intuitively how a student with a higher SLR would be more likely to graduate than a student with a lower SLR. It is also easy to understand intuitively how a full-time student would be more likely to graduate on time than a part-time student; likewise, it is self-evident that students enrolling for fewer terms are more likely to graduate on time. Perhaps the most interesting finding was that non-traditional age students are more likely to graduate than traditional age students, $OR = .809$, $p = .015$, 95% CI [.682 .960]. This finding is only significant at $p = .015$ post hoc. It is worth further research into the relationships among SLR, non-traditional age students, and graduation.

Research Question 3. In what ways does a correlation between the Successful Learning Rate and Graduation Rate suggest changing the definition of "normal time to completion" and the existing 150% threshold?

Findings. Because the correlation between the SLR and Graduation Rate was so small, it is difficult to make the argument that such a correlation suggests changing the definition of "normal time to completion" or the existing 150% threshold. Neither the data nor the statistical analyses support making those changes.

Discussion. Although the SLR does not appear to be a particularly robust predictor of graduation, it may still serve as a vehicle for telling the story of

student success. As previously stated, it adheres to the criteria of good indicators.

Coupled with qualitative student information, the SLR could still serve as one

quantitative indicator inside a larger narrative about student success.

This research question was predicated on the implied H_1 that a correlation

between SLR and eventual graduation would reveal previously unexamined

relationships that might point to better measures for community college student

success. Although this study did not produce an "a-ha!" moment, it does lay the

groundwork for further research. It suggests that research into indicators and

predictors of success for non-traditional age students may yield new insights into

describing success for that subset of students.

Summary

This study was undertaken based on calls for better indicators of success in

community colleges than graduation rates. One model was proposed by the

University of Alaska, and it appeared to have some promise as such an indicator:

the Student Learning Progress Model, of which the SLR is the core measure. A

review of the literature revealed four themes in this area: (a) the characteristics of

good indicators, (b) student characteristics affecting graduation rates, (c)

institutional characteristics affecting graduation rates, and (d) indicators related to

the Successful Learning Rate.

This quasi-experimental study was designed to explore whether there was a

correlation between the SLR and graduation. To this end a mid-sized, suburban

community college's historical transcripts were studied. The result was that there

was a very small, almost negligible correlation between the SLR and graduation.

Looking more deeply at the data revealed a few statistically significant facts about the SLR. First, it varied depending on student characteristics; gender was not a factor, but student attendance (full-time or part-time) was one and student age (traditional or non-traditional) was another. One unexpected finding was that non-traditional age students were more likely to graduate than traditional age students. This may be an area worth further research to better understand this subset of the student population.

While there is other research that implicitly suggests that a change may be in order for the 150% threshold for community colleges (Russ-Eft, Hindman, & Clemetsen, 2016), the SLR does not appear to contribute much to that discussion. Nonetheless, the SLR may still serve as a descriptor of student success, especially when paired with other qualitative measures to tell the student's individual story of success.

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Table 3.1

Data Elements and Their Operational Definitions

Data Element	Operational Definition
Time to completion	The time-to-completion is calculated as the number of terms from the first enrollment until completion of a credential.
Number of terms completed	Interval-level data recorded as the total number of quarters that the student was enrolled during the defined 10-year (40-quarter) cohort period.
Number of courses attempted	Ratio-level data recorded as the number of courses for which the student registered and received any grade of A, B, C, D, F, P (pass), or NP (no pass).
Number of courses passed	Ratio-level data recorded as the number of courses for which the student registered and earned a grade of A, B, C, D, or P (pass).
Number of courses failed	Ratio-level data recorded as the number of courses for which the student registered and earned a grade of F or NP (no pass).
Other grade notations	W (withdrawn)*, X (audit), Y (never attended), NULL (the word NULL in place of a grade), or <blank>. Courses with these notations were discarded from the final analysis.

Data Elements and Their Operational Definitions (Continued)

Successful Learning Rate	Ratio-level data computed by dividing the number of courses passed by the number of courses attempted.
Graduation (Graduation status)	An award achieved for completing a specific sequence of courses leading to either a degree or a certificate; nominal-level dichotomous data recorded as graduated (1) or non-graduated (0).
Graduation rate	Calculated as the percentage of students who complete a degree/certificate within 150% of the time it would take as a full-time student; for example, a two-year degree should take no more than three years.
Gender	Categorical data recorded as male, female, or undeclared.
Attendance (Full- or part-time status)	Full-time status describes a student who takes 12 or more credits per quarter, whereas a part-time student takes 1-11 credits per quarter; categorical dichotomous data recorded as full-time (1) or part-time (0)
Age (Traditional- or non-traditional-age)	Traditional-age students are 18-24 years old, whereas non-traditional-age students are over age 25; categorical dichotomous data recorded as non-traditional-age (1) or traditional age (0)

Table 3.2

Characteristics of the Population Examined

Characteristic	$N = 51,115$	
Gender		
Female	22,559	44.13%
Male	25,726	50.33%
Undeclared	2,830	5.54%
Attendance		
Full-time	12,630	24.71%
Part-time	38,485	75.29%
Age		
Traditional (18-24)	15,667	30.65%
Non-traditional (25+)	35,448	69.35%
Graduation status		
Graduated within 150%	1,920	3.76%
Graduated over 150%	1,926	3.77%
Did not graduate	47,269	92.48%

Note. Some student records did not include a gender marker. In these cases, they were listed as Undeclared.

Table 3.3

Characteristics of Females (n = 22,559), Males (n = 25,726), and Undeclared (n = 2,830)

Characteristic	Female	%	Male	%	Undeclared	%
Attendance						
Full-time	5,942	26.34%	6,512	25.31%	176	6.22%
Part-time	16,617	73.66%	19,214	74.69%	2,654	93.78%
Age						
Traditional (18-24)	6,898	30.58%	8,221	31.96%	548	19.36%
Non-traditional (25+)	15,661	69.42%	17,505	68.04%	2,282	80.64%
Graduation Status						
Graduated within 150%	1,050	4.65%	853	3.32%	17	0.60%
Graduated over 150%	1,068	4.73%	848	3.30%	10	0.35%
Did not graduate	20,441	90.61%	24,025	93.39%	2,803	99.05%

Table 3.4

Characteristics of Full-Time (n = 12,630) and Part-Time (n = 38,485)

Characteristic	Full-time	%	Part-time	%
Gender				
Female	5,942	47.05%	16,617	43.18%
Male	6,512	51.56%	19,214	49.93%
Undeclared	176	1.39%	2,654	6.90%
Age				
Traditional (18-24)	5,543	43.89%	10,124	26.31%
Non-traditional (25+)	7,087	56.11%	28,361	73.69%
Graduation Status				
Graduated within 150%	1,200	9.51%	720	1.87%
Graduated over 150%	799	6.33%	1,127	2.93%
Did not graduate	10,631	84.16%	36,638	95.20%

Table 3.5

Characteristics of Traditional Age (n = 15,667) and
Non-Traditional Age (n = 35,448)

Characteristic	Traditional Age	%	Non-Traditional Age	%
Gender				
Female	6,898	44.03%	15,661	44.18%
Male	8,221	52.47%	17,505	49.38%
Undeclared	548	3.50%	2,282	6.44%
Attendance				
Full-time	5,543	35.38%	7,087	19.99%
Part-time	10,124	64.62%	28,361	80.01%
Graduation Status				
Graduated within 150%	432	2.76%	1,488	4.20%
Graduated over 150%	605	3.86%	1,321	3.73%
Did not graduate	14,630	93.38%	32,639	92.08%

Table 3.6

Characteristics of Students Who Graduated Within 150% of Normal Time To Completion (n = 1,920), Students Who Graduated Over 150% of Normal Time To Completion (n = 1,926), and Students Who Did Not Graduate (n = 47,269)

Characteristic	Graduate in 150%	%	Graduate > 150%	%	Did not graduate	%
Gender						
Female	1,050	54.69%	1,068	55.45%	20,441	43.24%
Male	853	44.42%	848	44.03%	24,025	50.83%
Undeclared	17	0.89%	10	0.52%	2,803	5.93%
Attendance						
Full-time	1,200	62.55%	799	41.48%	10,631	22.49%
Part-time	720	37.45%	1,127	58.52%	36,638	77.51%
Age						
Traditional (18-24)	432	22.50%	605	31.36%	14,630	30.95%
Non-traditional (25+)	1,488	77.50%	1,321	68.64%	32,639	69.05%

Table 3.7

Means and Standard Deviations for SLR by Graduation and Counted Graduation

Variable	*n*	*M*	*SD*	*U*	*p*
Countable graduation				36,453,580.50	< .001
Graduated on time	1,919	.99	.04		
Graduated over time or did not graduate	45,746	.88	.26		
Any graduation				77,096,045.50	< .001
Graduated	3,842	.98	.05		
Did not graduate	43,823	.88	.26		

Table 3.8

Means and Standard Deviations for SLR by Gender, Attendance Type, and Age

Variable	*n*	*M*	*SD*	*U*	*p*
Gender				249,957,559.50	.180
Female	21,015	.88	.26		
Male	23,931	.88	.26		
Attendance type				158,960,495.00	< .001
Part-time	35,391	.91	.25		
Full-time	12,274	.83	.28		
Age				187,968,753.00	< .001
Traditional age	14,780	.83	.29		
Non-traditional age	32,885	.91	.24		

Table 3.9

Summary of Logistic Regression for Predicting Successful Graduation

Predictor	β	SE	Wald	OR	p	95% CI	
						LL	UL
SLR	.063	.01	40.48	1.065	<.001	1.045	1.086
Terms Enrolled	-.307	.01	637.57	.736	<.001	.718	.753
Female	.079	.08	1.04	1.083	.307	.930	1.261
Part Time	-.994	.08	157.39	.370	<.001	.317	.432
Traditional Age	-.212	.09	5.88	.809	.015	.682	.960

Note.: $\chi^2(5) = 1260.405$, $p < .001$, Nagelkerke $R^2 = .375$.

Chapter 4: General Conclusions

The purpose of this chapter is to tie together the previous chapters and to summarize the results of the present study. In addition, it will draw the reader's attention to limitations of the study, identify some areas for potential future research, and suggest some practical implications.

Discussion about Chapter 1

The primary motivating factor for this study was the need to find a measure of success better suited to community colleges. Unlike their four-year counterparts in higher education, community colleges have multiple divergent missions: college transfer, technical/vocational education, community education, high school completion, and workforce development, to name a few. Unlike their four-year counterparts, community colleges have open enrollment policies: no students are rejected, all students are accepted. Test scores are used for placement, not as a reason to deny admission. Community colleges are never flagship schools, land grant schools, or elite schools; rather, their roots are in the communities that they serve.

Does it make sense, then, to measure community colleges by the same yardstick used to measure Harvard, Michigan, or Oregon State University? Might the students in community colleges attend those colleges with different goals in mind than students attending four-year institutions? And might the goals of the students impact the graduation rates used to measure the institutions' success?

This researcher believes so. With experience in three community colleges, in both the roles of faculty member and administrator, it makes sense, both intuitively and experientially, that community colleges require a different measure to convey the various types of success that their students achieve.

Thus began the need examine this topic in depth.

Discussion about Chapter 2 / Manuscript 1

Manuscript 1 details the steps taken to understand the issues and set them into a structured context. First, there were discussions about the Student Learning Progress Model, of which the SLR is the central measure, with two institutional researchers developing and beta testing it. Second, there was much reading very broadly in the field to become more familiar with the discussions taking place about measuring and reporting student success. Third, there was an intense literature search process to identify gaps in the literature that held potential for study.

The literature review in Chapter 2 / Manuscript 1 is the result of that work. It set the context for the present study, and it situated it within the broader scope of the scholarly literature. The literature review was designed with two purposes in mind: It can stand alone to serve as a springboard for other researchers doing similar work, and it set the stage for the current study.

Discussion about Chapter 3 / Manuscript 2

Manuscript 2 details the method, analysis, and findings of the research. The SLR is the ratio of courses attempted to courses completed. Because this study

examined existing historical transcript data collected in the course of a college's

normal business, and because the data could be sanitized of personally identifiable

information by college staff before being released to the researcher, there was no

threat to the subjects or their privacy. This study was approved as exempt from

further IRB oversight.

Given that the SLR has not been studied as an indicator of student success

or as a predictor of eventual graduation, it made sense to approach this as an

exploratory study. Fundamentally, was there any type of association between a

student's SLR and eventual graduation? It would be useful to know whether any

type of relationship existed. Did a student's gender affect it in any way? What

might a student's type of attendance (part-time versus full-time) have? What effect

might a student's age (traditional versus non-traditional) have?

The results of the study were not all that one might have hoped for. There

was a very, very slight positive correlation between a higher SLR and eventual

graduation – so slight as to be virtually negligible and of no further statistical

interest. Among students who did graduate, the SLR, the students' type of

attendance, and the students' age were statistically significant predictors.

Ultimately, the SLR was not that interesting, quantitatively speaking. The

researcher acknowledges that it still has value when used as part of a larger

narrative to tell the story of student success.

Limitations of the Study

This study looked at the SLR of students at one community college and whether the SLR correlated with eventual graduation. This is merely a start. This work has significant limitations that form the basis of potential future research:

1. This study was conducted at a single medium-sized, suburban community college. Conducting this study using data from multiple community colleges would smooth out some of the data irregularities encountered at just one institution. Further, a much larger interstate study would allow for comparisons among sub-groups of community colleges, e.g., urban versus suburban versus rural. Such studies might yield different and/or more generalizable results.

2. The participating college had a relatively small data warehouse and limited staff to pull data and sanitize it of personally identifiable information. Working with other community colleges might have yielded deeper, richer data sets. For example, checking the SLR over multiple rolling cohorts at a single college would have allowed for in-college data validation, something lacking in this study because of the shallow data set.

3. The data examined were not as complete as one might prefer. Some term data were missing or incomplete, and many of the data were coded inconsistently. A grant-funded study would have allowed hiring of an assistant to search for missing data and to normalize inconsistently coded data.

4. The data set examined did not include student characteristics that may have contributed to a more nuanced study, e.g., race, previous educational background, language used at home, and socioeconomic background. Other colleges may track that information, and it may have demonstrated additional associations between the SLR and other variables not examined in this study.

5. This study examined the college-level, adult student population as a whole. It did not break out the population by program or major. The SLR might have demonstrated more significant relationships when focused on specific programs. Examining transcripts and recoding based on (likely) intended program might have revealed relationships that were not contemplated in this study.

6. The SLR has not yet been examined in relation to the non-college population. That covers a lot of ground in community colleges. Although it would not address the need for a better metric than graduation rate, there might be some unanticipated utility in applying the SLR to a different community college population.

Recommendations for Future Research

As stated before, this study was by its nature very limited. While the SLR returned disappointing research results with this data set, another data set may reveal more meaningful results. Future research is called for.

This study did not find a particularly significant correlation between the SLR and eventual graduation. There was an interesting apparent relationship between attendance status and student age that is worth additional exploration. Although perhaps not as broadly applicable as the SLR was thought to be, looking more closely at the SLRs of full-time, non-traditional age students may reveal new relationships not previously contemplated.

Another area to be explored is dual-enrollment programs. Dual-enrollment students and credits were excluded from this study because of concerns about the privacy of subjects under the age of 18. A different research design and more IRB oversight would address those concerns, and such research could lead to valuable new information on this population.

A different, more granular application of the SLR might yield more interesting results. Returning to Sollimo's original application of the "Success Ratio," a study could be constructed for individual departments to track success in pre-requisite and required courses by program, aiding in student advising. This more focused program-by-program approach might lead to a discovery of stronger relationships than the present study's general, all-college approach.

There are still many possibilities of finding quantitative data to support the SLR's use as an indicator of success and as a predictor for graduation. The focus of this study did not lead to a fruitful conclusion. That said, the SLR's greatest utility simply may not have been discovered yet. Further research is both justified and required.

Implications for Practice

It was originally thought that the SLR might slot into the role of a special indicator of success for community college students: it met the criteria for good indicators; it focused on accumulating success along the way, not just at degree or certificate completion; and it included all students, not just first-time, fall-term enrollees. It simply did not pass muster as having any useful relationship to eventual graduation.

It is important not to discard the SLR outright because this study did not discover a relationship between the SLR and graduation. The SLR may still prove useful to practitioners. It can still be used to tell the story of student success, even if not as a predictor of student success.

For example, the SLR in combination with a student's grade point average might be used to show an employer that the student has taken courses, earned a grade, and passed every course. This could be useful for students whose employer reimburses for continuing education; the SLR could demonstrate a passing grade on the first try rather than a few tries before finally passing.

In other situations, the SLR can be used to identify courses with lower pass rates. For example, this can help educators identify courses that may need content or structural review. It can also help educators identify sequences of courses that have different pass/fail rates, indicating that course articulation is not smooth for students. Conversely, it can help educators identify sequences of courses that have

identical pass/fail rates, potentially indicating that the sequence provides a smooth transition for students.

If courses or sequences of courses with problems are identified, educators can adjust course content and/or course delivery. They can work with publishers to develop instructional materials that meet the needs of students better. They can also work with student support services (e.g., academic advising, tutoring, or the library) to provide extra help and resources that students need to succeed.

In the aggregate, the SLR can still be used as a marketing tool for the institution. It is easy for education consumers to understand numerical scores, hence the use of graduation rates. It is easy for education consumers to compare those scores fairly, in an "apples to apples" way. Schools with higher SLRs can communicate to potential students that students are taking and passing courses at a high rate. In this respect, the SLR may be perceived as a more honest indicator of institutional success than graduation rate.

Lessons Learned

Undertaking a study of this type is not without its challenges. First and foremost, it would have been much easier and faster to have approached this as a grant-funded study. Grant money would have allowed the hiring of one or two assistants to manually standardize the data sets and to pursue missing data. Grant funding would also have allowed the purchase of a more powerful computer to process such a large dataset without seeking (even more expensive) consulting help.

Second, building additional strong relationships early on would have helped the data retrieval process considerably. When the first-choice institution unexpectedly fell through, one was left scrambling to find another willing partner in a very small field of possible partners. This factor alone added 18 months to the process.

Third, it is important to know when to ask for help. For example, there was a problem in managing large data sets that at first appeared to be a lack of familiarity with SPSS. It took weeks and working with a consultant to determine that the problem was not with SPSS, but rather with the hardware and operating system of the computer. One should trust one's instincts sooner and approach the problem differently.

Fourth, life inevitably happens when one is trying to conduct research. Illnesses, job changes, family emergencies, and other crises always happen at the most inconvenient times and in the most inconvenient ways. The life of the mind is to be treasured, but it is important to make backup plans for times when other parts of life demand one's attention.

Fifth, one can get lost in a sea of data. Even though this data set lacked some additional student characteristics that might have been interesting to examine, it was still an ocean's worth of data. It was very easy to lose track of time while taking deep dives into narrow areas of focus. It was easy to start chasing other tantalizing patterns taking shape. It was tempting to keep exploring the data to find new things hidden just out of reach. And it was also possible to metaphorically

"drown" in the data. It turned out to be very important to come up for air periodically and refocus on the research questions.

Concluding Thoughts

Undertaking a doctoral program is not something to be considered lightly. There is an opportunity cost: time with family, time to relax, time to enjoy hobbies, and time to engage with one's community. There is a financial cost: tuition and fees, books and supplies, transportation and lodging, and food. There is a health cost: lost sleep, groggy days, sore eyes, headaches, and carpal tunnel problems. There is a mental/emotional cost: Am I smart enough? What if people find out that I don't belong here? Is it fair for me to pursue this instead of doing all the other things people count on me for? What if I'm not good enough? In all ways, the cost of doctoral education is very, very high.   It probably should be to discourage attempts by people who are not 100% sure that it is what they want to do.

A doctoral program is also transformational. One enters the program as an educated person, as someone who has experience and expertise in a particular field. During the program, one is challenged to think in new ways and to see with new eyes. Upon completion of the program, one does not simply become a better practitioner for having learned more.

Instead, one becomes a philosopher who contemplates not only *what* is known, but also *how* it is known. One learns to fit new information into a mental framework that turns information into knowledge. One shares that knowledge so that others can build on it. Working together and building on each other's

knowledge, scholars help make the world a better place simply by asking questions and finding answers.

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Appendices

Appendix A: Purpose and Organization of Methods

The purpose of this research was to explore whether the *Successful*

Learning Rate might serve as a viable indicator of success in place of or in addition

to graduation rate. Specifically, this study examined whether the Successful

Learning Rate has any statistically significant correlation with graduation, both

within and beyond the traditional 150% normal time to completion measure: is

150% an arbitrary window? Is it reasonable to move the goalpost for community

college students if a more realistic timeframe is discovered? Does the strength or

relationship of such a correlation change based on various student characteristics

(male vs. female, full-time vs. part-time, or traditional age vs. non-traditional age)?

The results of this research provide institutions of higher education with another

tool to describe student and institutional success. The results will also inform

administrators, researchers, and policy makers.

This section describes: (a) the epistemological framework; (b) the type of

study; (c) the data collection method; (d) the data preparation method; (e) the data

analysis methods; (f) steps that were taken to ensure validity and reliability of the

data examined; and (g) steps that were taken to safeguard the privacy of the

transcript data analyzed.

Epistemological framework. This study was constructed according to a

Post-positivist epistemology. This section: (a) discusses the relationship of

epistemologies to research designs; (b) contrasts Positivism and Post-positivism as

epistemologies; and (c) relates the Post-positivist epistemology to the proposed research.

Epistemologies. Epistemology is a branch of philosophy that considers the nature of knowledge and the process of acquiring and validating knowledge. There are alternate schools of thought on the nature of knowledge (Gall, Gall, & Borg, 2007). The fundamental question of epistemology is this: How do we know what we know?

Before attempting to answer research questions, it is worth examining the various approaches to knowing and understanding. One scholar who has examined this question in depth is W. Lawrence Neuman. To frame the topic of epistemology, Neuman (2011, p. 94) posed 10 questions about the nature of knowledge:

1. What is the ultimate purpose of conducting social scientific research?
2. What is the fundamental nature of social reality?
3. What is the basic nature of human beings?
4. What is the view on human agency (free will, volition, and rationality)?
5. What is the relationship between science and common sense?
6. What constitutes an explanation or theory of social reality?
7. How does one determine whether an explanation is true or false?
8. What does good evidence or factual information look like?
9. What is the relevance or use of social scientific knowledge?
10. Where do sociopolitical values enter into science?

He applied these questions to various existing epistemologies, and he divided epistemologies into three broad categories: (a) Positivist Social Science (PSS); (b) Interpretive Social Science (ISS); and (c) Critical Social Science (CSS). He included Post-positivism in the umbrella term of Positivist Social Science. He

acknowledged his definition of Interpretive Social Science was also known as Constructionism.

Positivist Social Science deals with an objective world of knowable facts. Interpretive Social Science deals with a world of subjectively knowable facts, the understanding of which is bound by individual and shared interpretation of facts; facts only have meaning subjectively, and there is no objectively knowable reality. Critical Social Science takes Interpretive Social Science a step further, as it demands action to effect change in favor of social justice. Positivist Social Science lends itself to quantitative research designs, whereas Interpretive Social Science and Critical Social Science lend themselves to qualitative research designs (Neuman, 2011).

Other scholars categorize epistemologies differently. Schutt (2009) divides epistemologies into two broad categories. *Interpretivism* and *Constructivism* fall into one category. Interpretivism is concerned with the nature of socially constructed reality and the meaning given to it by participants. Constructivism builds on Interpretivism's philosophy as it seeks to answer how individuals come together as a group to construct a shared reality. These epistemologies lend themselves to qualitative research designs.

Schutt's (2009) second category includes *Positivism* and *Post-positivism*. Positivism is concerned with the objective nature of reality that exists apart from individual experiences. Post-positivism allows for an objective reality, but it also acknowledges that it can only be imperfectly perceived through the subjectively

biased experiences of researchers. These epistemologies lend themselves to quantitative research designs.

Creswell (2009) makes similar distinctions. *Constructivism* and a *Participatory Worldview* (i.e., CSS & ISS) suggest qualitative research designs: ethnography, narrative, etc. *Positivism* and *Post-positivism* suggest quantitative research designs: experimental, quasi-experimental, correlational, etc. Creswell describes a third category, *Pragmatism*, which suggests a mixed-method design, using both quantitative and qualitative approaches.

Gall, Gall, and Borg (2007) neatly summarize the epistemological issues inherent in educational research. By staking out particular epistemological positions, researchers conduct and advocate different types of educational research driven by their epistemologies.

Positivism and post-positivism. Positivism is an epistemology wherein reality exists independently of the individuals observing it. It is separate from individual experience and interpretation. It is describable, measurable, and knowable, revealing universal laws that underlie reality. Individuals who observe and report on reality in an unbiased way add to scientific knowledge (Gall, Gall, and Borg, 2007).

Schutt (2009, p. 90-92) advanced eight guidelines for conducting Positivist research:

1. Test ideas against empirical reality without becoming too personally invested in a particular outcome.
2. Plan and carry out investigations systematically.

3. Document all procedures and disclose them publicly.
4. Clarify assumptions.
5. Specify the meaning of all the terms.
6. Maintain a skeptical stance toward current knowledge.
7. Replicate research and build social theory.
8. Search for regularities or patterns.

Weaknesses began to become apparent in Positivism as an epistemology within the last hundred years. To understand the weaknesses in Positivism, Gall, Gall, and Borg (2007) present the hypothetical case of an educational researcher who examined classroom control. "Classroom control" might be defined in various ways: following instructions, not speaking out of turn, etc. Because of the values associated with different definitions, there is no way to collect data about the objective reality of classroom control.

Post-positivism addresses this limitation of Positivism. Post-positivism recognizes that there is an objective reality, but that it can only be known imperfectly through subjective human experience. Post-positivism advances hypotheses about the nature of reality, and researchers test those hypotheses. The more resistant a hypothesis becomes to refutation after repeated tests, the stronger and more valid the hypothesis becomes (Gall, Gall, and Borg, 2007).

Similar to Schutt's guidelines for Positivist research, Gall, Gall, and Borg (2007, p. 18-21) advanced six practices that they consider characteristic of Post-positivist research:

1. The creation of concepts and procedures that are shared and publicly accessible.
2. The replicability of findings.
3. The refutability of knowledge claims.

4. Control for errors and biases.
5. Boundedness of knowledge claims.
6. A moral commitment to progressive discourse.

To offer another perspective on the characteristics of Post-positivism, Neuman (2011, p. 100) advanced 10 characteristics summarizing this epistemology:

1. The purpose of social science is to discover laws.
2. An *essentialist* view is that reality is empirically evident.
3. Humans are rational, thinking, individualistic mammals.
4. A *deterministic* stance is taken regarding human agency.
5. Scientific knowledge is different from and superior to all other knowledge.
6. Explanations are *nomothetic* and advance via deductive reasoning.
7. Explanations are verified using *replication* by other researchers.
8. Social science evidence requires *intersubjectivity*.
9. An *instrumental orientation* is taken toward knowledge that is used from a *technocratic perspective*.
10. Social science should be *value free* and objective.

In these lists, certain constants emerge. Objective reality and universal laws exist. Humans have biases that may taint their view of objective reality and universal laws; these biases must be controlled as much as possible when conducting research. Hypotheses are tested and retested to determine whether they can be refuted. Hypotheses can become stronger and more valid, although never truly proven as objective reality.

Relating the post-positivist epistemology to this study. Recognizing that this study is subject to the value biases of the researcher, it is important not to discount these biases and to disclose them fully (Schutt, 2009). The fact that the

researcher undertook this study may be considered a subjective value judgment about the importance of the issues examined.

Under these circumstances, a Post-positivist epistemology logically fit with a quantitative approach to the research. Because the study examined whether there might a relationship among continuous and dichotomous variables, a quantitative design was called for (Creswell, 2009). Post-positivism and quantitative research fit comfortably together (Creswell, 2009; Gall, Gall, and Borg, 2007; Neuman, 2011; Schutt, 2009).

Appendix B: Data Preparation

As previously described, the data were collected from the participating college's record-keeping system by the college's Institutional Research staff. The data were conveyed to the researcher in the form of six data files and one text file describing the specifications of the other files.

The first four data files contained the same type of enrollment data divided into different periods: 2003-2006, 2007-2009, 2010-2012, and 2013-Current. The fifth data file contained student demographic data. The sixth data file contained academic credentials awarded.

Enrollment Data. There were three types of data used in this study: the enrollment data, the student data, and the award data. This section describes the preparation done to the enrollment data so that it could be examined. Table B.1 provides a summary of these steps.

The first four files were aggregated into one large master enrollment file of 977,843 course enrollment records. The Successful Learning Rate was designed to be applied only to college-credit coursework. Because community colleges offer many different types of coursework, the aggregated file needed some preparation before analysis.

While students could (and did) enroll in both college-credit and non-college-credit courses concurrently, the non-college-credit coursework does not affect a college's graduation rate. The context of this study is to look at ways of demonstrating student success and how it impacts institutional success other than

graduation rate. This study excluded anything that was not demonstrably college-credit coursework. Doing this restricted the focus to just the core college-credit course enrollment data for which the Successful Learning Rate was designed.

The first step of data preparation was to remove obviously non-college-credit coursework from the master file. College-credit courses were coded CCC; non-college-credit courses were coded CEU (continuing/community education), EXM (credit by examination), NCW ("nursing course work"), NOT (not college-level), TIN (transferred in), or blank.

The first courses removed were those that were coded CEU. These were courses taken as continuing or community education. Courses in this category included CPR and Japanese Style Pruning, for example. From 2003 to the present, this accounted for 21,059 course enrollments.

The next courses removed were those that were coded EXM. These were courses where credit was earned by examination or by advanced placement courses in high school. Courses in this category included Spanish 101 and College Algebra, for example. This accounted for 596 course enrollments. (While these are technically not enrollments, they were recorded on transcripts as if they were course enrollments, but they were coded differently for reporting purposes.)

The next group of courses removed from the aggregate was a special case coded NCW. These were field placement/practicum courses required of student nurse assistants only. Each registration represents 82 clinical hours, even though zero credit is granted. Although a case might me made that continuance in these

courses is technically the same as a Pass in a Pass/No-pass course, there was no specific indication of a Pass/No-pass grade in the record. The researcher applied the exclusionary principle discussed above. This accounted for 212 course enrollments.

More courses excluded from the aggregate were the NOT courses. These were courses that carried credit, but not college-level credit. Examples of these courses are English as a second Language, Adult High School Diploma completion, and Developmental Math. From 2003 to the present, this accounted for 113,242 course enrollments.

The TIN courses were the next group excluded. Although these are by definition college-level courses, these credits were transferred in as a one-time block of credit. There is no way to examine these courses over time, as the dates for any of this prior coursework were lost. The only date recorded was the term when the block transferred in. If a hypothetical student transferred in for fall term 2016 with 75 credits, there would be no useful way to follow the student's Successful Learning Rate over time. For the purposes of this study, these enrollments were excluded so that they would not skew the results. This accounted for 4,871 course enrollments.

The final group of records to be excluded were those records with blank course enrollment data. The records were simply blank or corrupted or an artifact of incorrect data entry. There were 415 of these records.

After the first round of data preparation based on the course type, the

aggregate file of enrollment data shrank from 977,843 to 837,448 course

enrollment records. This round of data preparation removed non-college-credit

courses by their course coding. The remaining 837,448 course enrollment records

theoretically contained only college-credit courses, at least by the dominant coding

scheme used in the registrar's office.

The second round of data preparation further focused the records to be

studied. In this round, the course enrollment records under examination were those

that used a slightly different coding scheme than that used in the first round.

Because of software and functionality updates to the course enrollment software

over the prior decade, course enrollment records in this group still contained

courses that should be excluded from the overall file. Enrollment records examined

this time were coded as dual-enrollment, Adult Basic Education/General Education

Development (ABE/GED), and custom-designed workforce training courses.

Dual-enrollment courses were the first group to be removed during this

round. Dual-enrollment courses are high-school courses that carry college-level

credit. High school students are "dual enrolled" in both the local high school and

the community college. Teachers of dual-enrollment courses are licensed high

school teachers who have been certified as eligible for community college faculty

status. Students take these courses in their high school, but they receive

transcripted college credit for them at the community college. These courses are

different from Advanced Placement courses, which are audited by the College

Board and accepted at many colleges and universities in the US and Canada. Dual-

enrollment courses are a local arrangement between the high school and the community college. Because of a patchwork of agreements around the state, these courses may be generally transferrable to other colleges and universities within Oregon.

Because dual-enrollment courses are taught in high schools, there is no way to know the age of the students. So, in the interest of not using data from minors, all of these records were excluded. That removed 51,356 course enrollment records from the total.

The next records examined in this round of data preparation are ABE/GED courses. These Adult Basic Education courses lead to the GED high school equivalency award. This is different from the Adult High School Diploma completion program records removed in the first round of data preparation. This college offers students a choice of completing a true high school diploma or a GED equivalency, depending on student needs. 8,232 course enrollment records were removed for being coded as ABE/GED.

The final records examined in this round of data preparation were those coded as customized training. These courses are typically developed by the college for local businesses to meet their needs for continuing certification, safety certification, or other business- or regulation-driven needs. They are similar to the continuing and community education courses like CPR, although they are more specific and more focused on a business's particular needs. An example might be a special two-week course on safely handling hazardous chemicals used by HVAC

companies. These are transcripted so that workers and businesses can demonstrate that they have arranged appropriate training to meet business or regulatory requirements. These courses accounted for another 23,742 enrollment records.

After the second round of data preparation, the total number of course-enrollment records shrank from 837,448 to 754,118 enrollment records. This level of specificity further removed records that were outside the scope of this study. This provided still greater focus and less chance of skewing the outcome with questionable data. This led to a third and final round of data preparation of enrollment records to tie up any remaining loose ends.

The third round of data preparation was even more precise. At this point in the process, only very specific college-level coursework remained. Non-college-level coursework, non-college-credit coursework, and dual-enrollment coursework taken in high schools has been discarded from the data studied. The final round of data preparation was based solely on course grades.

The Successful Learning Rate is a simple ratio of courses passed to courses attempted. In the context of this study, the guiding research questions limit the focus to community college, college-level, college-credit courses. This does not leave much room for interpretation. That said, there remain a few more cases to be addressed, and therefore the need for one more round of data preparation.

The third and final round of data preparation examined grades that do not indicate passing or failing a course. These were the cases of audits, withdrawals, incompletes, unreported grades, students who never attended, and blank grades.

The first and easiest of these to address were the audits. Students registered for these courses specifically with the intent of not earning a grade. Audits accounted for 21,332 course enrollment records.

The second category was the withdrawals. Students registered for these courses, but they changed their intent at some point and withdrew. In the absence of other information about their motivations (Were they failing before withdrawing? Did outside circumstances beyond their control force them to withdraw? Were they course-shopping and using this as a placeholder until they got into another course?), and following the exclusion principle discussed earlier, these records were excluded. Withdrawals accounted for 52,031 enrollment records.

The third category was the incompletes. These are a little more ambiguous than the previous categories. Students registered for these courses, apparently with the intention of completing them, but they did not complete. So, in the absence of further information about the students' motivations, and following the exclusion principle, these records were excluded. Incompletes accounted for 10,597 enrollment records.

The fourth category was unreported grades. Fortunately, this was a very small number, as there were no good examples of nor explanations for courses with unreported grades. They were simply recorded as UG in enrollment records. These accounted for 465 enrollment records.

The fifth category was for students who apparently never showed up for a

course. Perhaps these students were course shopping, or perhaps they mis-registered for a different course or section, or perhaps something else entirely kept them from attending a course. Whatever the reason, this category affected 4,416 enrollment records.

The sixth category was for students whose grade was blank or recorded as NULL in the registration system. Distinct from unreported grades (UG), these records simply have a blank grade field or the word NULL. It was assumed that data was lost when transferring records into the college's data warehouse, and it has not yet been reconstructed from paper records. This was a high number, accounting for 27,614 enrollment records.

The final group of records to be excluded were those records with obviously incorrectly coded data. For example, some records had the CEU course type code entered in the grade field. Because there was no way to know with certainty how these records came to be this way, they were discarded from the data. There were 132 of these records.

After a third round of data preparation, the number of course enrollment records shrank from 754,118 to 637,531. This was the final round of data preparation of course enrollment records used for this study. This locked the enrollment data into the final form for analysis.

Student Data. Once the enrollment data were prepared, that left the student data and the award data to be prepared. This section describes the student data and the preparation done to it. Table B.2 provides a summary of these steps.

The student file as presented to the researcher included 105,915 unique student records. As part of the preparation process, records were removed from the master file to adhere to the original intent of the study.

Student data required less preparation than enrollment data. There was some overlap between the student data and the enrollment data. For example, course enrollment records were removed from the enrollment data based on dual enrollment in high school; corresponding dual enrollment categories were recorded as student characteristics in the student data file. Such overlapping categories were removed to bring the contents of the student data file into alignment with the course enrollment file and with the intent of this study.

There were four categories of data that had to be removed. A variation of the exclusionary rule applied to this data as it did to the enrollment data: Unless the data specifically fit into the criteria allowing it to be examined for the Successful Learning Rate, it was excluded to keep it from skewing the results. As a corollary, student data contained some unique information about the age of the students. All students under the age of 18 or of unknown age were excluded from the data.

The first category of students removed from the file were dually enrolled students. This accounted for 18,123 student records.

The second category of students removed from the file were those specifically under 18 years of age, even though they were not coded as high school students. This accounted for 2,271 student records.

The third category of students removed from the file were those whose age was unknown. This accounted for 25,354 student records.

The fourth and category of students removed from the file were those with course transfers from other colleges. Because there was no way to track the progress over time of transferred in blocks of credit, those records might have skewed the results. This accounted for 8,825 student records.

The fifth and final category of students removed from the file were those who earned adult high school diplomas. This accounted for 226 student records.

After this round of data preparation, the student file shrank from 105,914 student records to 51,115 records. This locked the student data into the final form for analysis.

Award Data. Once the enrollment and student data were prepared, that left the award data to be prepared. This section describes the award data and the shaping done to prepare it for examination. Table B.3 provides a summary of these steps.

This was the smallest set of data records, and it required the least preparation. The Adult High School Diploma was removed because it is not a college-level award. That accounted for 559 award data records. The Oregon Transfer Module was also removed because it is not a college level award; it is simply a block of credits equal to 45 credits, i.e., the first year of college (Oregon State University, 2016). This left a total of 10,467 awards, and it locked the data set into its final form for analysis.

Data Processing Correction. While the descriptive statistics were

produced based on 51,115 students records, final data processing revealed one

more correction. There were 3,450 students who had no SLR. These students only

registered for audits, or they withdrew, or they never attended, or their grade was

set to NULL or <blank>. These course records were excluded, but there were still

corresponding student records in the student file. When inferential statistics were

calculated, they were calculated on $n = 47,665$.

Table B.1

Preparing Course Enrollment Data Records (n = 977,834)

Code	Meaning of code	Number of records removed	Running total
CEU	Continuing/Community Education	21,059	956,784
EXM	Credit by Examination	596	956,188
NCW	Nursing Course Work	212	955,976
NOT	Not College Credit	113,242	842,734
TIN	Transferred In	4,871	837,863
<blank>	Nothing recorded, blank field	415	837,448
Dual-enroll	Dual-enrolled, HS & College	51,356	786,092
ABE/GED	Adult Basic Education / General Education Development	8,232	777,860
CustWkTr	Customized Workforce Training	23,742	754,118
X	Audit	21,332	732,786
W	Withdraw	52,031	680,755
I	Incomplete	10,597	670,158
UG	Unreported Grade	465	669,693
Y	Never Attended	4,416	665,277
NULL or <blank>	Nothing Recorded	27,614	637,663
<various>	Misc. Incorrect Coding	132	637,531
		Total	637,531

Table B.2

Preparing Student Data Records (n = 105,914)

Category of student	Number of records removed	Running total
High School student	18,123	87,791
Students under 18	2,271	85,520
Student's age unknown	25,354	60,166
Transferred in	8,825	51,341
Adult HS diploma students	226	51,115
	Total	51,115

Table B.3

Preparing Degree and Certificate Award Data Records (n = 12,037)

Type of record	Number of records removed	Running Total
Adult HS diplomas	559	11,478
Oregon Transfer Module	1,011	10,467
	Total	10,467