THE VALIDITY OF THE CAMPUSREADY SURVEY

by

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DISSERTATION ABSTRACT

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The purpose of this study is to examine the evidence underlying the claim that scores from CampusReady, a diagnostic measure of student college and career readiness, are valid indicators of student college and career readiness. Participants included 4,649 ninth through twelfth grade students from 19 schools who completed CampusReady in the 2012-13 school year.

The first research question tested my hypothesis that grade level would have an effect on CampusReady scores. There were statistically significant effects of grade level on scores in two subscales, and I controlled for grade level in subsequent analyses on those subscales. The second, third, and fourth research questions examined the differences in scores for subgroups of students to explore the evidence supporting the assumption that scores are free of sources of systematic error that would bias interpretation of student scores as indicators of college and career readiness. My hypothesis that students' background characteristics would have little to no effect on scores was confirmed for race/ethnicity and first language but not for mothers' education, which had medium effects on scores. The fifth and six research questions explored the assumption that students with higher CampusReady scores are more prepared for college and careers. My hypothesis that there would be small to moderate effects of students'

aspirations for after high school on CampusReady scores was confirmed, with higher scores for students who aspired to attend college than for students with other plans. My hypothesis that there would be small to moderate relationships between CampusReady scores and grade point average was also confirmed.

I conclude with a discussion of the implications and limitations of these results for the argument supporting the validity of CampusReady score interpretation as well as the implications of these results for future CampusReady validation research. This study concludes with the suggestion that measures of metacognitive learning skills, such as the CampusReady survey, show promise for measuring student preparation for college and careers when triangulated with other measures of college and career preparation.

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CHAPTER I

INTRODUCTION

The lack of preparation many students face when they leave high school and enter college or the workforce and methods used to address that preparation gap are a current focus in educational policy (U.S. Department of Education, 2009, 2010, 2014). This increased policy focus on college and career readiness reflects two fundamental shifts in the 21st century workplace: jobs are becoming increasingly technical and more individuals apply to and enroll in post-secondary education than ever before (Aud, et al., 2010, 2013; Carnevale, Smith & Strohl, 2010; U.S. Department of Labor, Bureau of Labor and Statistics, Current Population Survey, "BLS," 2013). However, many students struggle when they transition to college as reflected in the high rates of remediation and low graduation rates in colleges and universities (Aud, et al., 2010). This transition from high school to postsecondary education is particularly challenging for the growing numbers of college students from backgrounds that are traditionally underrepresented on college campuses: students of color and students from low-socioeconomic backgrounds (Antonio & Bersola, 2004; Aud, et al., 2010; Bell, Rowan-Kenyon & Perna, 2009; Bowen, Chingos, & McPherson, 2009; Cabrera & La Nasa, 2001; Merchant, 2004).

Measures of metacognitive learning skills show promise for addressing this gap when triangulated with the results of other measures of student preparation for college and careers (Barrick & Mount, 1991; Conley & Darling-Hammond, 2014; Goldberg, 1990; Morgeson, et al, 2007; Oswald, Schmitt, Kim, Ramsay, & Gillespie, 2004; Sedlacek, 1996, 2004; Sternberg, 2005, 2008, 2012).

The Four Keys to College and Career Readiness is a conceptual framework that includes many of the metacognitive learning skills that research suggests are associated with success in college and careers (Conley, 2014). In 2009, the Educational Policy Improvement Center (EPIC) designed CampusReady, a school-level diagnostic survey, to measure how well the skills and dispositions contained in the Four Keys are represented in a school's policies and instructional practices (Conley, 2014). Although EPIC designed CampusReady to be used as a school-level measure, users indicated that they wished to use the results for individual student-level interventions and supports and EPIC began providing students with individualized reports of their results in the fall of 2013.

CampusReady is less than five years old and, although the tool is supported by strong theory, evidence of the validity of score interpretation has yet to be collected and documented systematically. In particular, evidence must be collected to support the assumptions underlying the interpretation of CampusReady scores as indicators of students' college and career readiness to determine if student level reports can be relied upon for individual students to improve their college and career readiness. This study seeks to answer this question by examining the claims, assumptions, and evidence underlying the validity of CampusReady score interpretation.

Validity

Test *validity* is not a characteristic of a test but of test score interpretation: "validity refers to the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of tests" (AERA, APA, & NCME, 1999, p. 9). *Construct validity* is the degree to which test scores can be "interpreted as indicating a test taker's standing on the psychological construct measured by the test" (AERA, APA,

& NCME, 1999, p. 174). The term *construct* is defined as, "the concept or the characteristic that a test is designed to measure" (AERA, APA, & NCME, 1999, p. 173). Constructs are "theoretical variable[s]" that can be inferred from multiple sources of evidence including "the interrelations of the test scores with other variables, internal test structure, observations of response processes, as well as the content of the test" (AERA, APA, & NCME, 1999, p. 174). According to Crohnbach and Meehl (1955), "construct validation is involved whenever a test is to be interpreted as a measure of some attribute or quality which is not operationally defined" (p. 282). Because "all test scores are viewed as measures of some construct," the terms *validity* and *construct validity* are now considered to be synonyms (AERA, APA, & NCME, 1999, p. 174; Kane, 2001).

The validity field has shifted away from studies designed to collect discrete types of validity evidence (*e.g.*, content validity, concurrent validity, criterion validity, etc.) to a more unified, argument-based approach to validity (Kane, 1992, 2001). In the unified approach, test validity is demonstrated through the development of validity arguments, which Kane (1992) described as "practical arguments" (p. 527) because their construction will not result in definitive proof rather, "the plausibility of an assumption is judged in terms of all of the evidence for and against it" (p. 528). Building a clear, coherent, and plausible argument regarding the appropriate and inappropriate interpretation of test scores entails the identification of inherent assumptions and collection of the best available evidence to examine those assumptions (Kane, 1992). The assumptions and the evidence supporting those assumptions will vary depending on the population being tested, the test administration, and the testing context (Kane, 1992).

Evidence that validates one test score interpretation may not support a different interpretation of the same test scores, nevertheless, Kane identified six categories of inferences, related assumptions, and sources of evidence to support those inferences that should be addressed in a validity argument: theory-based inferences, observation, technical inferences, generalization, decision-based inferences, and extrapolation (1992). I use these categories of inference as a frame of reference for five assumptions that underpin the claim that CampusReady scores are valid indicators of students' college and career readiness, and I use these assumptions to organize the validity argument developed in this study. These categories and their related assumptions are summarized in the next sections.

Theory-based Inferences

The claim underlying CampusReady is that students' scores can be interpreted as valid indicators of their college and career readiness. The foundational theory-based inference behind this claim rests on the assumption that the theoretical model on which it is based, the Four Keys, represents constructs associated with success in college and careers. The evidence supporting this assumption is presented in the next chapter which discusses the use of theoretical frameworks and their measures in industrial/occupational psychology to predict job performance, higher education admissions to promote campus diversity within the constraints of the Equal Protection clause, and K-12 education as part of a movement to prepare more students for the rigors of college and the work place. This historical and contextual evidence indicates that students' metacognitive learning skills, such as those contained in the Four Keys model, are associated with positive outcomes in college and careers (Barrick & Mount, 1991; Conley, 2014; Goldberg, 1990; Morgeson,

et al, 2007; Oswald, Schmitt, Kim, Ramsay, & Gillespie, 2004; Sedlacek, 1996, 2004; Sternberg, 2005, 2008, 2012). The section continues with a presentation of the literature base that describes the relationships between the skills and behaviors in each of the Four Keys and student achievement in K-12 and college, and job performance. This empirical and theoretical evidence base ultimately supports the inference that the Four Keys model contains the constructs associated with success in college and careers (Credé & Kuncel, 2008; Richardson, Abraham, & Bond, 2012; Robbins, et al., 2004; Tett, Jackson, and Rothstein, 1991).

Observation-based and Technical Inferences

The second assumption underlying CampusReady score interpretation is that CampusReady measures the Four Keys. Basic to this assumption are technical inferences and the inference of observation, or that "the score results from an instance of the measurement procedure" (Kane, 1992, p. 529). The second part of chapter two describes CampusReady development, administration, and scoring procedures to provide evidence that CampusReady items accurately measure the constructs they are intended to measure. The section also examines evidence from two studies using factor analysis that indicates that CampusReady items group around the Four Keys model structure for the Key Cognitive Strategies and the Key Learning Skills and Techniques (Lombardi, Conley, Seburn, Downs, 2013; Lombardi, Seburn, & Conley, 2011a).

Generalization

Reliability refers to the degree to which scores are consistent and free of measurement error across items, examinees, and administrations (APA, AERA, & NCME, 2009). Where subscale scores are used in addition to total scores, as in the case

of CampusReady, the *Standards* specify that reliability statistics should be reported for each subscale (APA, AERA, & NCME, 2009). Like evidence of observation-based inferences, test reliability is necessary but not sufficient evidence of validity (Kane, 1992). The third section of chapter two presents reliability statistics for CampusReady scores in each Key and each subscale to support the third framing assumption, which is that CampusReady scores are generalizable across items, scorers, and occasions.

Decision-based Inferences

Decision-based inferences rest on "assumptions about the possible outcomes (intended and unintended) of the decision to be made and on the values associated with these different outcomes" (Kane, 1992, p. 530). The fourth section of chapter two presents evidence supporting the assumption that CampusReady scores are free of sources of systematic error that would bias interpretation of scores as indicators of students' college and career readiness. This section discusses the debate around the role of consequential evidence in validity studies and the potential risks and benefits of using CampusReady scores to make decisions about students.

Extrapolation

The fifth assumption is that students with higher CampusReady scores are more prepared for college and careers. This assumption depends on the inference that students' future performance in college and careers can be extrapolated from their CampusReady scores. Extrapolation is the inference that test scores can be used as "indications of nontest behavior" (Kane, 1992, p. 529). Criterion-related evidence supports this inference by demonstrating a relationship between test scores and the behavior the test purports to measure to provide support for the inference that test scores can be "extrapolated beyond

the testing context to various other contexts (e.g., the classroom, workplace)" (Kane, 2001, p. 330).

Purpose of This Study

The purpose of this study is to examine the evidence supporting the five assumptions underlying the claim that CampusReady scores are valid indicators of student college and career readiness. After exploring these assumptions in the second chapter, the third chapter presents the results from six research questions designed to provide additional evidence for the validity of CampusReady score interpretation. The research questions guiding this study are:

1. Do CampusReady scores differ significantly by grade level?
2. Do CampusReady scores differ significantly based on students' race/ethnicity and does that effect depend on grade level where grade level had a significant effect on CampusReady scores?
3. Do CampusReady scores differ significantly based on students' mother's education and does that effect depend on grade level where grade level had a significant effect on CampusReady scores?
4. Do CampusReady scores differ significantly based on students' first language and does that effect depend on grade level where grade level had a significant effect on CampusReady scores?
5. Do CampusReady scores differ significantly based on students' post-high school aspirations and does that effect depend on grade level where grade level had a significant effect on CampusReady scores?

6. What are the relationships between students' CampusReady scores and their high school GPA? How do these relationships differ by grade level?

The first research question sought to test my hypothesis that student grade level would have an effect on CampusReady scores in that older students would have significantly higher scores than younger students. Where there were statistically significant effects of grade level on CampusReady scores, I controlled for grade level in subsequent analyses.

The second, third and fourth research questions examined the differences in CampusReady scores for subgroups of students to explore the evidence supporting the assumption that CampusReady scores are free of sources of systematic error that would bias interpretation of student scores as indicators of college and career readiness. I hypothesized that students' background characteristics would have little to no effect on CampusReady scores.

The last assumption, which is that students with higher CampusReady scores are more prepared for college and careers, was explored through the fifth and six research questions. For the fifth research question, I hypothesized that there would be small to moderate effects of students' aspirations for after high school on CampusReady scores, with higher scores for students who aspired to attend college than for students with other plans. For the sixth research question, I hypothesized that there would be small to moderate relationships between CampusReady scores and grade point average. The answers to these research questions will provide preliminary consequential and criterion-related validity evidence of CampusReady student score interpretation.

CHAPTER II

REVIEW OF THE LITERATURE

The claim inherent in the use of CampusReady is that scores can be validly interpreted as indicators of students' college and career readiness. This claim is built on several assumptions which are presented throughout this chapter along with a discussion of the evidence supporting each assumption. First, this chapter explores evidence that the Four Keys contain the skills and dispositions associated with success in college and careers. Next, this chapter explores evidence that CampusReady measures the Four Keys. Third, this chapter explores evidence that CampusReady scores are generalizable across samples of items, scorers, and occaisions. Fourth, this chapter discusses evidence supporting the assumption that CampusReady scores are free of sources of systemmatic error that would bias interpretation of scores as indicators of students' college and career readiness. Finally, this chapter discusses evidence supporting the assumption that students with higher CampusReady scores are more prepared for college and careers.

Assumption One: The Four Keys Contains the Skills and Dispositions Associated with Success in College and Careers

This section presents evidence supporting the assumption that the Four Keys model contains the skills and dispositions associated with success in college and careers. The historical and contextual evidence presented in the first part of this section indicates that measures of metacognitive learning skills show promise for use in measuring students' preparation for college and careers (Barrick & Mount, 1991; Goldberg, 1990; Morgeson, et al, 2007; Oswald, Schmitt, Kim, Ramsay, & Gillespie, 2004; Sedlacek, 1996, 2004; Sternberg, 2005, 2008, 2012). The empirical and theoretical evidence

presented in the second part of this section supports the inference that the Four Keys model contains the constructs associated with success in college and careers (Credé & Kuncel, 2008; Richardson, Abraham, & Bond, 2012; Robbins, et al., 2004; Tett, Jackson, and Rothstein, 1991).

Theoretical and Empirical Evidence that Metacognitive Learning Skills Predict Success in College and Careers

Cognitive factors are the content knowledge and academic skills students acquire in school, whereas the term *noncognitive* is used to refer to those factors that are not purely cognitive such as personality traits, skills, and abilities (Conley, 2013; Farrington, et al., 2012; Sedlacek, 1996, 2004). Conley (2013) contends that this distinction presents a false dichotomy because the traits often referred to as noncognitive actually do require higher order thinking.

> Might what we observe when we look for noncognitive factors be a more complex form of cognition—a result of executive functioning by the brain as it monitors and adjusts to circumstances to accomplish specific aims and objectives? In other words, might these behaviors be manifestations not of feelings, but of metacognition—the mind's ability to reflect on how effectively it is handling the learning process as it doing so? (Conley, 2013, para. 3).

Conley (2013) posits that the term "metacognitive learning skills" (para. 7) is a more apt description of these factors and includes in that definition "all learning processes and behaviors involving any degree of reflection, learning-strategy selection, and intentional mental processing that can result in a student's improved ability to learn" (para 7.) I used this definition of metacognitive learning skills in this study.

I conducted an extensive review of the literature to identify the main theoretical models, empirical studies, and trends around the identification and measurement of metacognitive learning skills and their relationships with success in careers, college, and life. I collected references from academic databases in education, psychology, and general social science; citations identified in key reviews and meta-analyses; and professional recommendations. My search terms included *noncognitive skills, noncognitive factors, soft skills, interpersonal skills, intrapersonal skills, 21st Century Skills,* and their derivatives. I included frameworks and studies based on the following preferences:

- Empirical studies and theoretical models from experts in the fields of education (K-12 and higher education), social/personality psychology, and industrial/occupational psychology.
- Frameworks developed within the last 25 years and published in peer-reviewed journals.
- Meta-analyses of metacognitive constructs written in the last 15 years and published in peer-reviewed journals.

First, this section discusses the literature around the use of noncognitive models and assessments to predict success in college and careers in industrial/occupational psychology, higher education admissions, and K-12 education. Next, this section presents the literature around the relationships between the metacognitive learning skills in each of the Four Keys and achievement in K-12 education; college grades, graduation, and retention; and job performance.

Personality traits that predict career success. In 1936, Allport and Odbert created one of the earliest personality taxonomies, containing 18,000 terms that describe personality which were then classified into 4,500 stable traits (Goldberg, 1990). In the 1940s, Cattell studied scales and subscales of these terms and refined them into a model of Sixteen Personality Factors (16 PF) to explain individual differences in personality (Cattell, 1945; Cattell, Cattell, & Cattell, 1993). These factors are measured by the 16PF Questionnaire, a widely used personality test. Subsequent studies on the 16 PF had indicated that only five of the factors Cattell identified were replicable; these personality dimensions were called the Big Five Personality Dimensions (the Big Five) and they include *openness, conscientiousness, extraversion, agreeableness,* and *neuroticism* (Goldberg, 1990). The Big Five is tested by numerous measures including the Global 5 and the Hogan Personality Inventory (Hogan & Holland, 2002).

By the middle of the 20th century, the use of personality tests in personnel selection was generally considered inappropriate, however this view shifted in the early 1990s when meta-analyses by Barrick and Mount (1991) and by Tett, Jackson, and Rothstein (1991) presented evidence that personality measures were valid predictors of employee performance (Morgeson, et al, 2007). Barrick and Mount (1991) found that the Big Five had moderate relationships with job performance in five occupational areas: professionals, police, managers, sales, and skilled/semi-skilled jobs. Job performance was measured by ratings on job proficiency, training proficiency, and personnel data. Over all professional areas and criteria, extraversion accounted for 47% of the variance in job performance, emotional stability accounted for 60%, agreeableness accounted for 68%,

conscientiousness accounted for 68%, and openness to experience accounted for 51% of the variance in job performance (Barrick & Mount, 1991).

Tett, Jackson, and Rothstein (1991) confirmed those results, finding a small overall correlation between personality and job performance of 0.24. Judge, Higgins, Thoresen, Barrick (1999) also found that childhood scores on measures of three Big Five factors had small to medium sized relationships with career success: Extraversion (r = 0.18, n = 116), Openness (r = 0.26, n = 116), and Conscientiousness (r = 0.41, n = 116). Childhood general mental ability had a strong relationship with career success (r = 0.53, n = 116) and the Big Five combined with childhood mental ability had an even stronger relationship with career success (r = 0.64, n = 116). Childhood neuroticism (the opposite of emotional stability) had a negative relationship with career success (r = -0.34, n = 116).[1]

Other models based on the Big Five followed, including the Great Eight Competencies (the Great Eight) and the Performance Improvement Characteristics (Tables 2.1 and 2.2). The Great Eight are correlated with the Big Five but unlike the Big Five, which were derived from a personality taxonomy developed through lexical analysis, the Great Eight emerged from analyses of self- and manager ratings of workplace performance thus are criterion-based (Bartram, 2005). The Competency Potential Questionnaire and other assessments measure the Great Eight. There are small and medium sized relationships between these constructs and manager competency

[1]Measures of these dispositions also show some promise in predicting college readiness. Richardson, Abraham, and Bond (2012) found that Conscientiousness has a very small relationship with college GPA (r = 0.19, n = 27,875), as does Agreeableness (r = 0.07, n = 21,734), and Openness (or Intellect and Imagination, r = 0.09, n = 1,418), whereas Extraversion has a very small negative relationship with college GPA (r = -0.04, n = 23,730).

ratings of overall job performance (Bartram, 2005). The Great Eight are summarized in Table 2.1.

Table 2.1

The Great Eight Competencies and Definitions

Competency	Definition
Leading and Deciding	Takes control and exercises leadership. Initiates action, gives direction, and takes responsibility.
Supporting and Collaborating	Supports others and shows respect and positive regard for them in social situations. Puts people first, working effectively with individuals and teams, clients, and staff. Behaves consistently with clear personal values that complement those of the organization.
Interacting and Presenting	Communicates and networks effectively. Successfully persuades and influences others. Relates to others in a confident, relaxed manner.
Analyzing and Interpreting	Shows evidence of clear analytical thinking. Gets to the heart of complex problems and issues. Applies own expertise effectively. Quickly takes on new technology. Communicates well in writing.
Creating and conceptualizing	Works well in situations requiring openness to new ideas and experiences. Seeks out learning opportunities. Handles situations and problems with innovation and creativity. Thinks broadly and strategically. Supports and drives organizational change.
Organizing and executing	Plans ahead and works in a systematic and organized way. Follows directions and procedures. Focuses on customer satisfaction and delivers a quality service or product to the agree standards.
Adapting and coping	Adapts and responds well to change. Manages pressure effectively and copes well with setbacks.
Enterprising and performing	Focuses on results and achieving personal work objectives. Works best when work is related closely to results and the impact of personal efforts is obvious. Shows an understanding of business, commerce, and finance. Seeks opportunities for self-development and career advancement.

Note. Adapted from Bartram, 2005, p. 1187.

The Performance Improvement Characteristics ("PIC") were built on the Big Five and developed in order to improve personnel selection test validation and link personality constructs to outcome measures (Hogan & Holland, 2002). The PIC are measured by the Hogan Personality Inventory (HPI), which is based on the Big Five model, and used in the Performance Improvement Characteristics job analysis method to assess individual differences in job performance. The PIC are summarized in Table 2.2.

Table 2.2

The Performance Improvement Characteristics

Competency	Definition
Adjustment	Resilient, upbeat, and remaining calm under pressure
Ambition	Competitive, self-confident, and taking initiative
Sociability	Approachable, outgoing, and social
Likeability	Considerate, perceptive, tactful, and good natured
Prudence	Planful, controlled, and attentive to details
Intellectance	Imaginative, creative, open-minded, and analytical
School Success	Staying up-to-date on business and technical matters

Note. Adapted from Hogan & Holland, 2002, p. 3

This brief overview of the use of models and measures of metacognitive learning skills in career selection contexts demonstrates the history of using these measures for predicting job performance. The next part of this section discusses the use of noncognitive models and measures in higher education admissions.

Diversity in higher education admissions. In January of 2012, Educational Psychologist produced a special issue on college and university admissions with a focus on theory and measurement. This issue focused on the use of noncognitive assessments for admissions on some campuses in the context of race conscious admissions practices and the enrollment gap. Robert Sternberg wrote in the introduction to the issue that "those who design admissions procedures are the 'gatekeepers' of higher education and thus play a nontrivial role in shaping the direction of human society" (Sternberg, Gabora, & Bonney, 2012, p. 2). Meanwhile, institutions of higher education struggle to recruit students of color and low-income students and this challenge is particularly pronounced when research demonstrates that traditional measures used in college admissions are biased against students of color and low-income students. For example, White students' average scores on the SAT, ACT, GRE, GMAT, LSAT, and MCAT tend to be higher

than African American, Asian American, and Hispanic students' scores on those tests (Camara & Schmidt, 1999). In addition, White students' scores on the NELS:88 reading and math 12th grade assessments were higher than the scores of students of color, and in each ethnic group students from high-SES backgrounds scored higher than students from low- and middle-SES backgrounds (Camara & Schmidt, 1999).

In 2003 the United States Supreme Court held in two landmark cases that universities have compelling interests in promoting diversity through race-conscious admissions practices: *Grutter v. Bollinger* and *Gratz v. Bollinger*. In both of these cases, White students sued the University contending that they were denied admissions because students of color were admitted due to the University's race-conscious admissions policies. In *Gratz*, the Court affirmed their holding in the *Regents of the University of California v. Bakke* (1978) that universities have an interest in promoting diversity on campuses and that interest is compelling enough for universities to use race as a factor in admissions without violating the Fourteenth Amendment. However the use of racial quotas or points systems is not permissible. In *Grutter*, the court held that the Law School's race-conscious admissions policy was constitutional. Central to the Court's opinion in *Grutter* was that the Law School did not define diversity solely on ethnicity and that it did not use race as a predominant factor, but as one factor among several admissions criteria. In his majority opinion to *Bakke* Justice Powell asserted that "diversity that furthers a compelling state interest encompasses a far broader array of qualifications and characteristics, of which racial or ethnic origin is but a single, though important, element (*Bakke*, 1978, p. 437).

As demonstrated in these cases, the race-based enrollment gap in US colleges is wide enough that the Supreme Court has held that promoting diversity on college campuses is a compelling government interest, meaning that it is important enough that universities can use race as a factor in admitting students without violating the Fourteenth Amendment. However, race cannot be the only criterion for admissions and quotas or points systems cannot be used, race can only be considered individually along with other factors (*University of California v. Bakke*, 1978*; Gratz v. Bollinger*, 2003; *Fisher v. University of Texas*, 2012). Despite gaining the Court's permission to use race as a factor in admissions, a challenge persists in college admissions: how to recruit and enroll a diverse student body while at the same time efficiently processing the myriad applications received by universities each year?

In *Grutter v Bollinger*, Justice O'Connor's majority opinion stated that the University of Michigan Law School's policy of looking "beyond grades and scores to so-called 'soft variables,' such as recommenders' enthusiasm, the quality of the undergraduate institution and the applicants essay, and the areas and difficulty of undergraduate course selection" was permissible (p. 306). However, this type of holistic applicant review is not scalable outside of selective universities and graduate schools. In 2011, 8.2 million applications were submitted to U.S. colleges and universities (Clinedinst, Hurley, & Hawkins, 2011). In order to process these applications and admit diverse student bodies within the guidelines imposed by the Supreme Court, admissions offices seek systematic, easy to administer, and effective measures that are less prone to the biases of traditional college admissions measures and that contribute information about students' potential for success in college (Camara & Schmidt, 1999; Sedlacek,

2004; Soares, 2012, Sternberg, 2012). The models and measures of metacognitive learning skills used in college admissions and discussed here were developed in response to this challenge.

For instance, an early scholar in this area is Sedlacek, who developed a model of the noncognitive variables useful for admitting students from traditionally underrepresented populations to higher education. Sedlacek's Noncognitive Variables (1996, 2004) include positive self-concept or confidence, realistic self-appraisal (especially academic), successfully handling the system and/or racism, preference for long-term goals to short-term or immediate needs, the availability of a strong support person, leadership experience, community involvement, and knowledge acquired in a field. Sedlacek's model was designed to be more sensitive to non-dominant cultures than traditional admissions models, thus it attempts to account for ways of demonstrating these attributes that transcend mainstream culture. For instance, Sedlacek used "gang leader" as an example of the type of past experience that would demonstrate leadership (1996, 2004).

Many colleges and universities use Sedlacek's Noncognitive Questionnaire or modified versions as part of their admissions practices, for instance Oregon State University administers an open-ended questionnaire based on Sedlacek's model and several other universities have adapted and implemented Oregon State's questionnaire as part of their admissions process (Jaschik, 2013; Sandlin, 2008). Sedlacek and his colleagues have published numerous articles detailing the success of the tool in admitting underrepresented students to higher education and in predicting their success (see e.g., Noonan, Sedlacek, & Veerasamy, 2005; Sandlin & Sedlacek, 2006; Sedlacek, 1993,

1996, 2003, 2004, 2005, 2008, 2001; Tracey & Sedlacek, 1984). A metaanalysis of studies involving the Noncognitive Questionnaire demonstrated that the tool was indeed biased towards students from underrepresented groups, thus it would in fact work as an admissions tool that would allow universities to admit more underrepresented students (Thomas, Kuncel, & Credé, 2007). However, the tool was not a valid measure of students' success in college because results indicated that many of the constructs had little to no correlation with students' college GPA or retention: although it would not even rate as small according to Cohen's (1992) effect size criteria, self-concept had the strongest relationship with college persistence (r = 0.14, n = 2861) whereas nontraditional knowledge had a very small negative relationship with persistence (r = -0.08, n = 932, Thomas, Kuncel, & Credé, 2007). Thus the tool successfully discriminates between underrepresented and traditional students, however the underrepresented students it admits may not have the skills and dispositions required to succeed in college (Thomas, Kuncel, & Credé, 2007).

Another early model used in higher education is Tinto's (1975) Social Integration Theory which includes institutional factors like the commitment of the institution in increasing student success; high expectations institution-wide; academic, social, and financial support; academic and social integration; and how well the institution fosters learning. Tinto considered positive experiences on campus related to these factors central to students' integration in campus and integration was the key to persistence. Tinto's model is widely cited and there is evidence that students' academic and social engagement does affect persistence, however the evidence for the predictive power of the other factors is weak (Pascarella & Terenzini, 2005).

Another framework, Bean's Student Attrition model, was synthesized from a review of other models including Tinto's Social Integration Theory and theories related to worker turnover to articulate the factors that contribute to student persistence in higher education (Bean, 1980, 1985, 1987). Bean's theory includes students' background characteristics, students' financial resources, grades and academic performance, social factors, bureaucratic factors, external environment, psychological and attitudinal factors, institutional fit and commitment, and students' intentions (Bean, 1980, 1985, 1987; Bean & Metzner, 1985).

Sternberg developed a theory of successful intelligence called WICS, which stands for wisdom, intelligence, creativity, synthesized (Sternberg, Bonney, Gabora & Merrifield, 2012). This theory and its measure were developed to go beyond the traditional measures of intelligence in order to better capture the abilities required to succeed in every day life in the real world. Sternberg's WICS model includes the following constructs that people need to be successful: *creativity, analytical intelligence, practical intelligence,* and *wisdom*. This theory asserts that intelligence is not fixed and that improving the WICS skills improves individuals' leadership and citizenship. Sternberg applied this theory to college admissions through two studies, the Rainbow Project and the Kaleidoscope Project (Sternberg, 2009). In the Rainbow Project, an assessment based on this theory was developed and used for college admissions as a supplement to the SAT for 1,013 first-year college students at the University of Michigan (Sternberg, 2011). The researchers collected student's baseline data including standardized test scores and high school grade point average and administered assessments measuring the WICS model. *Analytical intelligence* was assessed through

the SAT and additional multiple-choice analytical items developed by the researchers. The researchers also developed multiple-choice, performance-based, and open-ended items to measure *creativity*; multiple-choice and situational judgment inventories to measure *practical intelligence. Wisdom* was not measured in this study. Results from this small study indicated that this measure predicted undergraduate GPA and added substantially to the predictive power of the SAT. Further, compared with the SAT, the measure did reduce ethnic subgroup differences, particularly for Latino and African American students.

In Project Kaleidoscope, items based on the WICS model of successful intelligence were added to the Tufts University application. This study was based on the Rainbow Project, but it also measured *wisdom* in addition as the other WICS constructs through a series of untimed essay questions on the Tufts-specific supplement to the common application (Sternberg, Bonney, Gabora, Merrifield, 2012). Admissions decisions were influenced by the quality of the essays or the evidence of creative, practical, or wisdom-based abilities and acceptance rates for applicants receiving an A were double the rates for applicants who did not receive an A on the essays. The researchers found that higher ratings on the essays predicted involvement in extracurricular and leadership activities (Sternberg, Bonney, Gabora, & Merrifield, 2012). These studies have limitations, particularly regarding their generalizability: both took place on single college campuses, University of Michigan and Tufts, with small convenience samples. Despite these limitations, they do indicate that measures of skills beyond content knowledge have some potential for use in college admissions, specifically

measures of students' ability to demonstrate wisdom through analytical intelligence, creativity, and practical intelligence.

Another model, the Twelve Dimensions of College Student Performance, was developed from a review of educational objectives and mission statements from 23 colleges to identify criteria for success in college (Friede, et al., 2002; Oswald, et al., 2004). The College Board and researchers at the University of Michigan developed two measures of these skills: a situational judgment inventory and a biodata measure and analyzed the relationships between students scores on subscales of the 12 dimensions and college cumulative GPA and absenteeism for a small sample of 654 students in one university (Schmitt, 2012). After high school GPA and ACT/SAT scores, the strongest relationships were between college GPA and *Knowledge* ($r = 0.26$), *Ethics* ($r = 0.16$), and *Perseverance* ($r = 0.06$). Only Knowledge would rate as small according to Cohen's (1992) effect size criteria, although correlates with small effects may nevertheless contribute additional useful information about students' potential, the constructs measured in these studies had such low predictive power they may be of little practical use in identifying college students' potential beyond their GPA and test scores.

These lackluster results may have been due to the methods used to identify the constructs contained in the Twelve Dimensions model. The researchers presented no evidence supporting the main assumption underlying their model, which was that the educational objectives and mission statements from 35 universities would relate to students' success at all universities. These universities were not selected at random and no direct evidence was presented regarding their representativeness of national institutions, although the researchers claimed that they "varied on characteristics such as

public/private and large/small enrollment" (Oswald, 2004, p. 191). Further, of the 35 institutions originally identified, only 23 were included because they provided "usable information. Institutions not providing usable information did not explicitly state their educational objectives or provide a university mission statement" that was accessible online and available through a web search (Oswald, 2004, p. 191). Although the researchers stated that they wished to incorporate a variety of stakeholders' voices in the process, they provided no information about the individuals who developed those objectives and mission statements and whose voices they represented.

This overview of the use of models and measures of metacognitive learning skills in higher education demonstrates that models of metacognitive skills and disposition and their measures may have some utility in predicting students' college readiness if the models used are supported by more evidence than the frameworks currently in use and discussed here. The next part of this section describes the current policy focus on college and career readiness and the use of college and career readiness models and measures in K-12 education.

College and career readiness. College and career readiness is one of the most pressing issues in educational policy today. *College and career readiness* is:

> The level of preparation a student needs to enroll and succeed—without remediation—in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program, or in a high-quality certificate program that enables students to enter a career pathway with potential future advancement (Conley, 2010, p. 21).

The stated goal of President Obama is to ensure that all students are ready for college and careers upon high school graduation. The Obama administration intends to codify this goal in the reauthorization of the *Elementary and Secondary Education Act* which will call for higher standards in English language arts and mathematics, assessments aligned with those standards, improved professional development, and evidence-based instructional models and supports (U.S. Department of Education, 2010). Similarly, the federal *Race to the Top* grant competition awards funds to states and districts that adopt reforms including standards and assessments aligned with these goals (U.S. Department of Education, 2009).

Another example of the current focus on college and career readiness in education policy is the adoption of the *Common Core State Standards* by 45 states. These standards were developed through a partnership between the Chief Council of State School Officers and the National Governors Association and were designed to ensure that students graduate from high school prepared to succeed in college and the workplace (National Governors Association, Center for Best Practices, and the Council of Chief State School Officers, 2010).

The achievement gap and college and career readiness. One reason for the increased policy focus on college and career readiness is that postsecondary education is increasingly important in today's workplace and yet the achievement gap or the occurrence that "one group of students outperforms another group, and the difference in average scores for the two groups is statistically significant (that is, larger than the margin of error)" persists beyond secondary school and into college and the workplace for individuals of color and those from low-income backgrounds (Aud, et al., 2013, p.

210). Results from the National Assessment of Educational Progress (NAEP) demonstrates the achievement gap in K-12: White students scored 26% higher than Hispanic and African American students on the eighth grade mathematics version of the NAEP and White students' scores on the eighth grade reading NAEP were 25% higher than Hispanic students' scores and 23% higher than African American students' scores (Hemphill & Vanneman, 2011; Vanneman, Hamilton, Baldwin Anderson, & Rahman, 2009).

The achievement gap follows students from high school into college. College access for underrepresented groups has increased but the enrollment and graduation rates of students of color and students from low-income backgrounds still lag behind those of White and higher-income students (Aud, et al., 2013; Carnevale & Strohl, 2013; Reardon, 2011). College enrollment is at an all-time high at 18 million undergraduate and three million graduate students and enrollment is projected to swell to 20 million students by 2018 (Aud, et al., 2013; Hussar & Bailey, 2009). Although college enrollment rates are swelling, particularly for students of color, fewer students of color are projected to enroll in college than White students, with 2018 enrollment increasing to:

- 12.2 million students who are White (a 4% increase),
- 3 million students who are African American (a 26% increase),
- 2.9 million students who are Latino (a 38% increase),
- 1.6 million students who are Asian/Pacific Islander (a 29% increase), and
- 300,000 students who are Native American or Alaska Native (a 32% increase) (Hussar & Bailey, 2009).

As demonstrated by these projections, the enrollment of students of color will increase proportionately but will still not match that of White students. Further, despite higher enrollment rates, college graduation rates are low for all students and particularly for students of color and low-income students. Approximately 57% of first-time college students seeking a bachelor's degree and enrolled full-time in a four year institution will graduate from college within six years, with higher graduation rates for Asian/Pacific Islander students (67%) and White students (60%) but lower rates for Hispanic/Latino students (48%), African American (42%), and American Indian/Alaska Native students (40%) (Aud, et al., 2010).

African American, Latino, and low-income students are also disproportionately concentrated in lower funded, open-access, two- and four-year colleges compared with their White peers (Carnevale & Strohl, 2013). Since 1995, most new White enrollments (82%) attended the 468 most selective colleges while most Latino (72%) and African American (68%) enrolled students attended open-access colleges (Carnevale & Strohl, 2013). The better funded, more selective colleges where White students are concentrated tend to have higher graduation rates, higher rates of students going on to graduate and professional schools, and better career outcomes when compared with the less selective colleges because the better funded schools have more resources to spend on students (Carnevale & Strohl, 2013).

College enrollment differs by the income levels of students as well: 25% fewer students from low-income families were enrolled in college than students from high-income families in 2008, the same enrollment gap that has persisted since 1972 (Antonio & Bersola, 2004; Aud, et al., 2010; Bell, Rowan-Kenyon, Perna, 2009; Cabrera & La

Nasa, 2001; Merchant, 2004). From 1972 to 2008, there was a 20% enrollment gap between high- and low-income students (Aud, et al., 2010). Even controlling for access to financial aid, high-income students are 55% more likely to apply to four-year colleges than their lowest-income counterparts, and low-income students are 15% less likely to apply than middle-upper income students (Cabrera & La Nasa, 2001).

These income-based enrollment and graduation gaps are so significant that the Obama administration released a call to action titled *Increasing College Opportunity for Low-Income Students* in which the administration outlined priorities and research-based strategies designed to improve the access to and success in higher education for low-income students (U.S. Department of Education, 2014).

The Obama administration's call to action around increasing opportunities for low-income students contains four major barriers for those students and research-based interventions to minimize those barriers (U.S. Department of Education, 2014). The first intervention proposed by the Obama administration is, "connecting more low-income students to college where they can succeed and encouraging completion once they arrive on campus" (U.S. Department of Education, 2014, p. 16). Although this approach is designed to reduce the phenomenon of *undermatching* for low-income students, *undermatches* are also common for African American and Latino students, and this approach can support those students as well (Bowen, Chingos, & McPherson, 2009).

Undermatching occurs when students are "presumptively qualified to attend strong four-year colleges but did not do so, instead attending less selective four-year colleges, two-year colleges, or no college at all" (Bowen, Chingos, & McPherson, 2009, p. 88). Students who attend selective colleges tend to graduate at higher rates and in

shorter periods of time than similar students at less selective universities and so undermatched students may be greatly disadvantaged by their institutional choice. This disadvantage is particularly impactful on African American students (particularly African American women) and students from low-SES backgrounds (based on family income and parental education levels) for whom undermatches are more common (Bowen, Chingos, & McPherson, 2009). For instance, just 27% of students from families in the highest income quartile were undermatched but 59% of students from families in the lowest income quartile were undermatched (Bowen, Chingos, & McPherson, 2009). While the causes of this undermatching are complex and vary by the student, Bowen, Chingos, and McPherson contend that the causes may be a combination of inertia and a lack of information, college planning, and encouragement. This phenomenon is also a potential explanation for the persistence of the achievement gap once students leave high school and enter college.

The second intervention proposed in *A Call to Action* is, "increasing the pool of students preparing for college" (U.S. Department of Education, 2014, p. 28). The third intervention is, "reducing inequalities in college advising and test preparation" (U.S. Department of Education, 2014, p. 35). These interventions seek to promote a culture of college preparation in middle and high schools through exposure to enrichment programs and STEM education, challenging curricula, more information about financial aid, mentorships, and high quality guidance counseling. Low-income students can benefit greatly from high quality guidance counseling because earning potential is increasingly closely tied to educational attainment: in 2011, median annual earnings for young adults with a bachelor's degree was approximately $45,000, 22% more than the $37,000 per

year earned by young adults with an associate's degree, 50% more than the $30,000 per year earned by those with a high school diploma, and 96% more than the $23,000 earned by those who had not earned a high school diploma or the equivalent (Aud, et al., 2013). In 2012 there was 6.8% unemployment overall, for individuals who had earned a bachelor's degree or higher that rate was 4.3% whereas it was 8.3% for individuals with only a high school diploma (BLS, 2013). The unemployment rates for White adults with a BA or higher was 3.7% whereas it was 6.3% for African American adults; for White adults who did not graduate from high school it was 11.4% as opposed to 20.4% for African American adults who did not finish high school (BLS, 2013).

These differences are minimized as individuals obtain more education. In 2008, African American and Hispanic young adults with a bachelor's degree or less education earned less than White young adults, however at the level of master's degree or higher there were no measurable differences in earnings for these groups (Aud, et al., 2010). Thus, education may be the key to minimizing these disparities however "the postsecondary system mimics and magnifies the racial and ethnic inequality in educational preparation it inherits from the K-12 system and then projects this inequality into the labor market" through phenomena like undermatching (Carnevale and Strohl, 2013, p. 7). Equitable and high quality programs designed to develop students' college and career readiness are vital to minimizing the income- and race-based differences in educational attainment and economic outcomes.

The fourth intervention is, "seeking breakthroughs in remedial education" (U.S. Department of Education, 2014, p. 41). This intervention is designed to reduce the number of students who enroll in remedial courses because there is evidence that many

students never move out of remedial education and into credit-bearing courses. The Obama administration presents a three-stage approach to addressing this intervention: better curricular alignment between high schools and colleges, better assessments for students entering postsecondary systems, and improved remedial courses.

As discussed in the next section, the development and measurement of students' metacognitive learning skills show promise in improving students' college and career readiness, particularly for students of color and those from low-income backgrounds. Measures like CampusReady could be used to support the assessment stage proposed by the Obama administration by diagnosing students' readiness for college and careers based on the Four Keys model.

Metacognitive learning skills and college and career readiness. Improving the development of students' metacognitive learning skills shows promise for improving student college and career readiness (Credé & Kuncel, 2008; Oswald, Schmitt, Kim, Ramsay, & Gillespie, 2004; Richardson, Abraham, & Bond, 2012; Robbins, et al., 2004; Sedlacek, 1996, 2004; Sternberg, 2005, 2008, 2012). In a meta-analysis of 7,167 studies examining the psychological correlates of college students' grade point average (GPA) 50 factors were identified from five overlapping domains: personality traits, motivational factors, self-regulatory learning strategies, students' approaches to learning, and psychosocial contextual influences (Richardson, Abraham, and Bond, 2012). Richardson, Abraham, and Bond observed the strongest relationships between college GPA and the motivational factors examined: *performance self-efficacy* was the strongest correlate, followed by high school GPA, ACT scores, and grade goals. *Time/study management* had a small relationship with college GPA. There were medium sized correlations between

college GPA and *academic self-efficacy* and *effort regulation*; and weak correlations between college GPA and *emotional intelligence, metacognition,* and the Big Five factor *conscientiousness*. Test anxiety and procrastination had large negative correlations with college GPA. Results of the Richardson, et al. (2012) study demonstrates that measures of these metacognitive learning skills show promise for assessing student preparation for college, particularly measures of the skills that show large and moderate relationships with college GPA.

Credé and Kuncel (2012) conducted a meta-analysis on the relationships between students' study habits, skills, and attitudes and college performance. Results of that study generally confirmed those of Richardson, et al. (2012), namely, the existence of a moderate relationship between college GPA and study habits, skills, and attitudes as well as the student attitudes towards learning. Results of the Credé and Kuncel (2012) study also confirmed the finding that *metacognition* explains about 3% of the variance in college GPA. None of the study skills factors had as large an effect on college GPA as *performance self-efficacy, grade goals, effort regulation,* or *academic self-efficacy* did in the Richardson, Abraham, and Bond study; although no one factor accounted for a large proportion of the variance, the aggregate measures explained 11% of the variance in college GPA (Credé and Kuncel, 2012). While most of these effects were small, they were on par with traditional measures including high school GPA and ACT scores which explained 16% of the variance, and SAT scores which explained 8% of the variance in college GPA (Richardson, Abraham and Bond, 2012).

This overview demonstrates that it is not unreasonable to consider measures of metacognitive learning skills for use in measuring students' preparation for college and

careers along with traditional measures (Barrick & Mount, 1991; Goldberg, 1990; Morgeson, et al, 2007; Oswald, Schmitt, Kim, Ramsay, & Gillespie, 2004; Sedlacek, 1996, 2004; Sternberg, 2005, 2008, 2012). The next section presents evidence of the degree to which the Four Keys model represents and describes the constructs associated with success in college and careers.

Theoretical and Empirical Support for the Four Keys Model

This section describes the empirical and theoretical support for the Four Keys model of college and career readiness (Conley, 2014). Conley first developed his model based on the results of the College Readiness Evaluation for Schools and Teachers (CREST) project, which was sponsored by the Bill and Melinda Gates Foundation (Conley, 2009, 2010) and other previous research (Conley, 2003). The CREST consisted of evidence from programs and practices at 38 high-performing high schools nationwide selected because they served populations typically underrepresented in higher education and were achieving better than expected results in preparing students for college. School characteristics such as school type and size, geographic setting and location, student body demographics, performance indicators, and, in particular, college readiness programs and practices were considered as schools were selected. Schools with high proportions of low-income students, English language learners, Latino students, and African American students were oversampled, as these groups are underrepresented in postsecondary education.

Site visits at each of the 38 schools took place between September 2007 and May 2008. During this time, EPIC researchers collected extensive information on the schools including classroom observations; school documents; and interviews and focus groups

with administrators, counselors, teachers, and students. The results from this study and previous research pointed to policies and practices that schools were employing to achieve high degrees of success for their students. The results from CRESST and subsequent studies formed the foundation and subsequent refinements of the Four Keys model (Conley, 2014). The Four Keys of College and Career Readiness is a theoretical framework organized into four domains: *Key Cognitive Strategies, Key Content Knowledge, Key Learning Skills and Strategies,* and *Key Transition Knowledge and Skills.* Within each of these domains, constructs are organized hierarchically into aspects and then components.

The following sections provide an overview of the Four Keys and the evidence of the relationships between the constructs contained in each of the Four Keys and success in K-12 education, college, and careers. This review of the literature indicates that the Four Keys contains metacognitive learning skills that students need to be ready for college and careers.

Key Cognitive Strategies. The Key Cognitive Strategies are "ways of thinking" that can help students succeed in post-secondary environments (Conley, 2014, p. 55). Findings from studies examining the expectations of college faculty, the content of college courses, high quality college readiness standards, and studies into the Common Core State Standards demonstrate that college instructors expect students think critically, conduct research, and produce high-quality written work that demonstrates a coherent line of reasoning (Conley, 2003, 2009; Conley, Drummond, de Gonzalez, Rooseboom, & Stout, 2011; National Governors Association, Center for Best Practices, and the Council of Chief State School Officers, 2010; National Research Council, 2011).

Similar attributes have also been identified as employability skills (Association for Career and Technical Education, 2010). Employers recognize these skills as essential for successful on-the-job performance and want to hire employees who possess effective communication, critical thinking, problem solving, and creativity skills (Conference Board et al., 2006; Hart Research Associates, 2010; Kyllonen, 2012; Saflund Institute, 2007). The Key Cognitive Strategies address this college and workplace expectation in that they describe the process of addressing a problem through collecting and analyzing information, communicating results, and maintaining appropriate precision throughout (Table 2.3).

Table 2.3

Key Cognitive Strategies: Aspects, Components, and Definitions

Aspect	Component
Problem Formulation: Students demonstrate clarity about the nature of the problem, identify potential outcomes, and develop strategies for exploring all components of the problem	**Hypothesize:** Students formulate a complete, comprehensive hypothesis that contains a cause-and-effect or thesis statement that is sufficient to formulate a potential solution to the task. **Strategize:** Students consider one or more plausible approaches that could lead to a solution and generate a feasible plan of action to implement the approach. In the process, students may revisit and revise the hypothesis as a result of thinking about potential methods to solve the problem.
Research: Students explore a full range of available resources and collection techniques or generate original data. They also make judgments about the sources of information or quality of the data, and determine the usefulness of the information or data collected.	**Identify:** Students consider a full range of appropriate resources and determine how and where to locate available informational material and source data. **Collect:** Students make judgments about available informational material and data sources, considering validity, credibility, and relevance. In addition, they collect information and data necessary to address the hypothesis. Students may revisit their resources and information collection process as their thinking evolves.

Table 2.3

Key Cognitive Strategies: Aspects, Components, and Definitions (Cont.)

Aspect	Component
Interpretation: Students identify and consider the most relevant information or findings. In order to make connections and draw conclusions, they need to use structures and strategies that contribute to the framework of communicating a solution. Reflecting on the quality of the conclusions drawn is an important part of this strategy.	**Analyze:** Students deconstruct information and data, select evidence, and use analytical tools to structure findings or insights. They look for patterns and relationships as the basis for developing ideas and insights relevant to the problem and its solution. **Evaluate:** Students group information into usable pieces, connect ideas and supporting evidence, and draw conclusions. They also reflect on the quality of the conclusions they have drawn.
Communication: Students organize information and insights into a structured line of reasoning and construct a coherent and complete final version through a process that includes drafting, incorporating feedback, reflecting, and revising.	**Organize:** Students incorporate ideas and supporting evidence purposefully using structures that demonstrate the line of reasoning. **Construct:** Students create a draft, incorporate feedback to make appropriate revisions, and present a final product that is appropriate for the purpose and the audience.
Precision & Accuracy: Students apply this strategy throughout the entire process. They are appropriately precise and accurate at all stages of the process, determining and using language, terms, expressions, rules, terminology, and conventions appropriate to the subject area and problem.	**Monitor:** Students determine and apply standards for precision and accuracy appropriate to the subject area throughout the task. **Confirm:** Students confirm that the final product meets all discipline-specific standards for precision and accuracy in language, terms, expressions, rules, terminology, and conventions.

Note: Adapted from Conley (2012, 2014)

There is empirical support for the inclusion of the Key Cognitive Strategies in a college readiness model: related dispositions, skills, and instructional strategies have small to moderate relationships with K-12 achievement and college GPA (see Table 2.4). For example, Richardson, Abraham, and Bond (2012) found that *critical thinking*, or the capacity to critically analyze learning material, had a small significant and positive relationship with college GPA ($r = 0.15$, $n = 3{,}824$). Lindner & Harris (1998) found that *executive processing*, which includes the process of analyzing the task, developing a strategy, monitoring cognition, and evaluating the strategy, had a small correlation with GPA in a small sample of undergraduate and graduate students ($r = .23$, $n = 256$, $p < .005$). At the K-12 level, instructional strategies around cognitive strategies can lead to

higher student achievement. For example, Hattie (2009) found that teaching strategies that involve *problem solving* had a medium sized relationship with student achievement in K-12 (d = 0.61, n = 15,235). Similarly, instructional strategies that involve *generating and testing hypotheses* (d = 0.61, k = 63 studies) had medium sized relationships with student achievement (Marzano, Gaddy & Dean, 2000).

Table 2.4

Effects of Constructs Related to Key Cognitive Strategies on K-12 Achievement and College GPA

Construct (authors)	Effect	*n*
Critical Thinking (Richardson, Abraham, and Bond, 2012)	0.15*	3,824
Need for cognition (Richardson, Abraham, and Bond, 2012)	0.19*	1,418
Openness (Richardson, Abraham, and Bond, 2012)	0.09*	23,096
Problem solving in math (Marcucci, 1980, as cited in Hattie, 2009)	0.35**	33 studies
Problem solving in science and math (Curbelo, 1984, as cited in Hattie, 2009)	0.54**	68 studies
Interpersonal cognitive problem solving (Almeida & Denham, 1984, as cited in Hattie, 2009)	0.72**	18 studies
Increasing cognitive flexibility (Mellinger, 1991, as cited in Hattie, 2009)	1.13**	25 studies
Problem solving instructional methods (Hembree, 1992, as cited in Hattie, 2009)	0.33**	55 studies
Problem solving in science (Taconis, Ferguson-Hessler, & Broekkamp, 2001, as cited in Hattie, 2009)	0.59**	22 studies
Instructional strategies that involve generating and testing hypotheses (Marzano, Gaddy & Dean, 2000)	0.61**	63 studies

*Relationship with college GPA; **Relationship with K-12 achievement

These cognitive skills, along with all of the skills and strategies outlined in the Four Keys, can and should be taught to students in order to prepare them for the rigors of college and careers (Conley, 2014; Halpern, 1998). However, despite the relationships between the use of cognitive strategies and success in college, many students leave high school without receiving instruction on how to complete assignments that require

cognitive engagement (Angus & Mirel, 1999; Brown & Conley, 2007; Conley, 2005). This may be due to the complexity of teaching these skills, for example teaching *Problem Formulation* may be counter-intuitive for teachers because they tend to articulate the problem to be solved for students rather than requiring students to formulate the problem on their own by presenting open-ended or challenging scenarios (Conley, 2014). *Research* can also be challenging to teach students in today's world, in part due to the plethora of low-quality information available online (Conley, 2014; Halpern, 1998). Halpern (1998) contends that many colleges now require students to take courses on how to critique and analyze information and media because so many students enter college with poor information literacy.

Another potential difficulty with teaching the Key Cognitive Strategies is that they are best taught embedded in content (Perkins & Salomon, 1989). Perkins and Salomon (1989) considered the question, "Are cognitive skills context-bound?" (p. 23) and determined that while there are some general cognitive strategies that will apply in all scenarios, expert use of these strategies is facilitated by contextual knowledge and vice versa: "general heuristics that fail to make contact with a rich domain-specific knowledge base are *weak.* But when a domain-specific knowledge base operates without general heuristics, it is brittle—it serves mostly in handling formulaic problems" (p. 23). This premise had its roots in the research around expertise, artificial intelligence, and transfer. The research into expertise indicates that there is a difference between the way novices approach problems and experts' approach (Conley, 2014; Perkins & Salomon, 1989). When approaching problems, experts access a repertoire of domain-specific patterns and extend those patterns to the problem to be solved (a process called *forward reasoning)*

whereas novices have no similar accessible database of patterns and so they must use *backward reasoning* to determine the unknown from the known (Perkins & Salomon, 1989). Novices develop surface strategies that are largely procedural in nature, while experts employ innovative and sophisticated strategies that involve critical thinking and deep processing (Alexander, et al., 2003; Conley, 2012; Vrugt & Oort, 2008). Surface strategies are not without merit. They are required for any task requiring rote memorization (e.g., for multiple-choice exams), and some theorists believe they are central to the development of foundational content knowledge (Vrugt & Oort, 2008). A surface approach to learning does have a relationship with undergraduate GPA, however the relationship between GPA and deep approaches to learning is stronger (Richardson, Abraham & Bond, 2012).

Similarly, work in Artificial Intelligence demonstrated that when humans and computers approach a completely new domain, they only have the ability to deploy a set of general heuristics, which tend to result in weak outcomes (Perkins & Salomon, 1989). These findings were supported by research into transfer that indicates that thinking is domain-specific and that transfer of knowledge and skills from one domain to another must be "cued, primed, and guided; it seldom occurs spontaneously" (Perkins & Salomon, 1989, p. 19). Thus, Perkins & Salomon contend that while there are some general cognitive skills, such as those described by the Key Cognitive Strategies, these skills function best when employed in context.

A combination of subject-specific critical thinking instruction with separate and explicit instruction in general critical thinking strategies (such as those outlined in the Key Cognitive Strategies) is most effective for developing students' cognitive strategies

(Abrami, et al., 2008; Conley, 2014; Perkins & Salomon, 1989). To better facilitate the development of students' Key Cognitive Strategies, they should be explicitly taught within the content areas through heavily scaffolded, challenging, open-ended assignments that require students to exercise the full range of strategies (Capon & Kuhn, 2004; Dochy, Segers, Van den Bossche & Gijbels, 2003; Ericson & Charness, 1994; Hmelo-Silver, 2004; Pease & Kuhn, 2011). Students will progress along a continuum from novice to expert as they develop these strategies along with content knowledge (Baxter & Glaser, 1997; Conley, 2014; Perkins & Salomon, 1989).

> **Key Content Knowledge.** Key Content Knowledge (KCK) is defined as:
>
> The foundational content and big ideas from core subjects that all students must know well, and to the understanding of the big ideas in core subject areas that enable students to gain insight into and retain what they are learning. Also included in this key are the technical knowledge and skills associated with specific career aspirations, the ways in which students interact with content knowledge, its perceived value to them, the effort they are willing to expend to learn necessary content, and their explanations of why they succeed or fail in mastering this knowledge. (Conley, 2014, pp. 55-56)

The structure of Key Content Knowledge differs from the other Keys. It contains two aspects, described in Table 2.5, but unlike the other Keys it does not include discrete components.

Table 2.5

Key Content Knowledge: Aspects, Components, and Definitions

Aspect	Component
Structure of Knowledge: Gain expertise in subject matter and be able to apply terminology, facts, and concepts to new contexts.	Cultivate developmentally appropriate mastery of subject matter knowledge along the novice to expert continuum in the core content areas; including reading and writing, mathematics, science, social studies, and art. This refers to the knowledge traditionally described by standards and taught in schools.
Student Characteristics: Possess the individual characteristics that are necessary to become an expert in anything.	Understand that intelligence is malleable, and can be changed through increased effort; that effort is under one's own control and is applied more easily when motivation is high, academic topics relate to real world contexts that are intrinsically interesting and relevant, and academic challenges are welcome rather than avoided.

Note: Adapted from Conley (2012, 2014)

The first aspect is *Structure of Knowledge*, or "the big ideas and how those ideas frame the study of the subject" (Conley, 2014, p. 65). This structure of knowledge provides students with an organizing schema for the key terms and vocabulary students learn in each subject area in order to facilitate deeper understandings and retention of subject knowledge. The second aspect, *Student Characteristics* aspect overlaps with and relates to the constructs described in the *Student Ownership of Learning* aspect in that they both involve the student's approach to learning, however the skills and strategies described in the *Student Ownership of Learning* aspect are general approaches that students can apply to a range of scenarios whereas the *Student Characteristics* aspect describes the student's approach to mastering the core content areas: English/language arts, mathematics, social studies, and science.

Key Content Knowledge does not refer to students' academic proficiency, rather it refers to students' approach to learning and their beliefs and values towards schoolwork. The Four Keys differs from most other college and career readiness

standards (for example, ACT's College Readiness Benchmarks) in that they are not a set of instructional standards or cut scores on tests of content knowledge. The Twelve Dimensions of College Performance frames students' relationship with content knowledge similarly: *Knowledge and mastery of general principals* is defined as "gaining knowledge and mastering facts, ideas, and theories and how they interrelate, and the relevant contexts in which knowledge is developed and applied. Grades or GPA can indicate, but not guarantee, success on this dimension" (Oswald, et al., 2004, p. 189). Schmitt (2012) found that this construct has a small relationship with college GPA (r = .26, n = 1165, $p < .05$) and a small negative relationship with college absenteeism (r = -.16, n = 555, $p < .05$).

The strategies students choose to engage with content knowledge reflect their development along a continuum from novice to expert, with novices developing surface strategies that are largely procedural in nature and experts developing innovative and deep strategies that involve *critical thinking* and *deep processing* (Alexander, et al., 2003; Conley, 2012, 2014; Vrugt & Oort, 2008). Deep processing, or "attempting to understand material by integrating it within one's existing knowledge structure" had a small relationship with college GPA and performance in individual college classes (Credé & Kuncel, 2008, p. 429). *Deep approach to learning*, or the "combination of deep information processing and a self-intrinsic motivation to learn" has a small relationship with college GPA as well (Richardson, Abraham, and Bond, 2012, p. 358). Richardson, Abraham, and Bond (2012) found that a *surface approach to learning*, defined as "a combination of shallow information processing and an extrinsic motivation to learn" has a small negative relationship with undergraduate GPA (Richardson, Abraham & Bond,

2012). Surface strategies are not completely without merit, they are required for any task requiring rote memorization (e.g., for multiple-choice exams), and some theorists believe they are central to the development of the foundation of knowledge (Elliot & Harackiewicz, 1996; Vrugt & Oort, 2008).

The skills and strategies articulated in Key Content Knowledge require students to engage with learning content on a deep level and involve students' ability to *transfer* knowledge from one scenario to another (Conley, 2014). Transfer is when a "knowledge or skill associated with one context reaches out to enhance another" (Perkins & Salomon, 2001, p. 370). Some content knowledge transfers more easily from one context to another, such as reading, writing, and math, whereas other knowledge does not easily transfer to new situations. Just as a novice engages in procedural surface strategies, "low road" transfer is the transfer of procedural knowledge through an "automatic triggering of well-practiced routines" across similar contexts (Perkins & Salomon, 2001, p. 373). On the other hand, "high road" transfer involves the "deliberate, mindful abstraction of skill or knowledge from one context for application in another" (Perkins & Salomon, 2001, p. 373).

Conley's definition of Key Content Knowledge describes this deliberate, metacognitive process of understanding how all knowledge can be transferred from one context to another. This process overlaps with the Key Cognitive Strategies described in the previous section in that it requires students to think critically about information and engage in it on a very deep level. It also overlaps with the Key Learning Skills and Techniques described in the next section in that it requires students to develop the self-

awareness and metacognitive skills to adapt study strategies to the task at hand and to stand back from what they are learning think about how to apply it to new situations. There is empirical support for the inclusion of Key Content Knowledge in a college readiness model: related dispositions, skills, and instructional strategies have small to moderate relationships with K-12 achievement and college GPA (see Table 2.6).

Table 2.6

Effects of Constructs Related to Key Content Knowledge on K-12 Achievement and College GPA

Construct (authors)	Effect	*n*
HSGPA (Richardson, Abraham & Bond, 2012)	0.40*	31,971
High school grades to university grades (Schuler, Funke, & Barn-Boldt, 1990, as cited in Hattie, 2009)	1.02*	63 studies
ACT (Richardson, Abraham & Bond, 2012)	0.40*	34,724
SAT (Richardson, Abraham & Bond, 2012)	0.29*	22,289
Deep Processing (Credé & Kuncel, 2008, p. 429)	0.12*	4,238
Deep Approach to Learning (Richardson, Abraham, and Bond, 2012, p. 358).	0.14*	5,211
Student attitudes to science (Wilson, 1983, as cited in Hattie, 2009)	0.32**	43 studies
Student attitudes to mathematics (Bradford, 1990, as cited in Hattie, 2009)	0.29**	102 studies
Student attitudes to mathematics (Ma & Kishor, 1997, as cited in Hattie, 2009)	0.47**	143 studies
Ability related to science learning (Boulanger, 1981, as cited in Hattie, 2009)	1.09**	34 studies
Intelligence and achievement (Hattie & Hansford, 1983, as cited in Hattie, 2009)	1.19**	72 studies
Academic and occupational performance (Samson, Graue, Weinstein & Walberg, 1984, as cited in Hattie 2009)	0.31***	35 studies

*Relationship with college GPA; **Relationship with K-12 achievement; ***Relationship with job performance.

Key Learning Skills and Techniques. The Key Learning Skills and Techniques are the self-management skills, attitudes, and habits necessary for students to learn and perform appropriately, effectively, and efficiently. The Key Learning Skills and Techniques consists of two aspects: student ownership of learning and the specific

learning techniques students must master, such as time management or study skills and these aspects are further specified into components such as *goal setting*, *time management*, and *note taking*. These aspects, components, and their definitions are described in Table 2.7 and explored in the following sections.

Table 2.7

Key Learning Skills and Techniques: Aspects, Components, and Definitions

Aspect	Component
Ownership of Learning: Engage in, interact with, and be responsible for continually learning new knowledge and skills. Good teaching is not enough.	**Goal Setting:** Identify short- and long-term goals that align with aspirations as well as strengths and weaknesses, identify the steps necessary to attain those goals, and make timely progress toward those goals. **Persistence:** Persevere when faced with new, challenging, or unfamiliar tasks; assume responsibility for completing tasks as assigned. **Self-Awareness:** Monitor the self as it evolves and grows to assess strengths, weaknesses, and interests; work toward improving weaknesses and to aligning goals to strengths and interests. **Motivation:** Self-motivate to find value in intrinsically uninteresting tasks, expend the effort necessary to remain engaged and motivated to compete tasks. **Help Seeking:** Become familiar with personal resources available in the current environment, be aware of progress on current tasks enough to know when help is needed, and appropriately utilize resources to receive the help needed. **Progress Monitoring:** Continually evaluate progress toward goals and the alignment between aspirations, qualifications, and evolving skills and interests.

Table 2.7

Key Learning Skills and Techniques: Aspects, Components, and Definitions (cont.)

Aspect	Component
Learning Skills: Possess a variety of tools and techniques that are necessary to learn and do new things.	**Self-Efficacy:** Be confident in one's ability to complete increasingly challenging and complex academic and career tasks; be able to build on past experiences and success to maximize future successes. **Technology Proficiency:** Develop sufficient familiarity and proficiency with the specific technology and technical tools used in the academic or career choice of interest. **Memorization and Recall:** Possess multiple effective strategies and devices to memorize and recall facts and terms. **Collaborative Learning:** Develop the skills and strategies necessary to communicate and work collaboratively with diverse groups to meet specific objectives. **Time Management:** Apply skills and strategies necessary to prioritize, plan, and sufficiently focus one's attention to get expected tasks completed on time. **Test Taking:** Be able to prepare for the assessment of one's knowledge and proficiencies; includes being able to recall and apply information in real time and in a variety of academic and applied assessment and evaluation contexts (quizzes, academic tests, performance reviews and evaluations, etc.). **Note Taking:** Possess the strategies and skills necessary to prioritize, attend to, and record important information from texts, lectures, meetings, and tasks; includes referring back to notes as needed to more effectively complete future tasks. **Strategic Reading:** Be able to employ a variety of strategies to identify and extract relevant information from a variety of texts and formats that are specific to the chosen academic or career environment.

Note: Adapted from Conley (2012, 2014)

Student ownership of learning. The literature on the elements of the ownership of learning aspect of the Four Keys is summarized in the following sections that discuss motivation and engagement, goal orientation and self-direction, self-efficacy and self-confidence, metacognition and self-monitoring, and persistence. The strategies students use to set academic and personal goals for high school and beyond, identify resources and steps to attain these aspirations, and persist in pursuing them are a common factor among the literature reviewed here and an important element of student ownership of learning.

Central to the notion student ownership of learning is awareness of and involvement in the learning process.

Students taking ownership of learning begins with *motivation* (Conley, 2014). Motivation and engagement are closely related: motivation is an internal state, while engagement is the manifestation of motivation behaviorally. Engagement can be thought of as comprising three components: behavioral engagement (compliance with norms and expectations), emotional engagement (interest, enjoyment), and cognitive engagement (investment in learning, challenge-seeking) (Fredricks, Blumenfeld, & Paris, 2004; Trowler, 2010). Behavioral engagement may not be enough for students to succeed in college and careers where higher order thinking is required, motivation must manifest itself in the potential for self-guided action, and students must be both emotionally and cognitively engaged to succeed (Conley, 2007, 2010). Indeed, academic *intrinsic* motivation, or "self-motivation for and enjoyment of academic learning and tasks" is more strongly correlated with college GPA than academic *extrinsic* motivation, or "learning and involvement in academic tasks for instrumental reasons" (Richardson, Abraham & Bond, 2012, pp. 357-58).

When students are engaged and interested in what they are learning, greater learning gains occur. Compliance-based learning, where the learner simply waits to be told what to do and then follows directions, results in lower quality academic products (Richardson, Abraham & Bond, 2012). Student engagement leads to higher achievement in the classroom (Finn, 1993, 1989; Finn & Rock, 1997; Newmann, 1992; Marks & Coll, 2007). At the college level, engagement is significantly and positively related to students' grade point average (GPA), performance in individual classes, and retention (Credé &

Kuncel, 2008; Richardson, Abraham & Bond, 2012; Robbins, et al., 2004). The converse is also true in that a lack of engagement adversely affects student achievement (Finn, 1989; Finn & Rock, 1997; Steinberg, 1996; Wehlage, Rutter, Smith, Lesko & Fernandez, 1989).

The second student ownership of learning element reviewed is *goal setting* (Conley, 2014). Students who are motivated and engaged then need to have strong goal orientation and self-direction to be successful in school and careers. Academic goals are positively and significantly related to K-12 student achievement, college students' grade point average and college retention (Marzano, Gaddy & Dean, 2000; Richardson, Abraham & Bond, 2012; Robbins, et al., 2004). Goal attainment hinges on the ability to exercise control over one's behavior. An individual's intention to pursue a goal is not enough if that goal is beyond the individual's influence (Ajzen, 1991; Bandura, 1977; Locke & Latham, 1990, 2006). A person's perceptions of behavioral control can be a key predictor of his or her behavior in situations that are not completely under the person's volition (Ajzen, 1991). Teaching students that academic goals are within their control is the first step in promoting students' goal orientation, which is associated with academic achievement (Cury, Elliot, Da Fonseca, & Miller, 2006; Dweck & Legget, 1988; Midgley & Urdan, 2001; Roeser, Midgley, & Urdan, 1996; Shim, Ryan, & Anderson, 2008; Wolters, 2004).

Students with high goal orientation have a *growth mindset* and approach tasks as learning opportunities (Dweck & Legett, 1988). Students *fixed mindsets* believe their intellectual capacity is finite; these students seek to opportunities to prove what they already know and avoid failure (Dweck & Legett, 1988). Cognitive research has

confirmed that intelligence is not fixed, but can change over time (Ramsden, et al., 2011). A growth or mastery-oriented mindset towards goal achievement helps empower students to believe that they can develop their cognitive capabilities and improve their performance. Students with a mastery-oriented mindset enjoy challenge, are willing to engage in difficult tasks, and employ strategies to cope with obstacles, whereas students with a compliance mindset avoid challenge, are unable to function effectively in the face of obstacles, and attribute failure to personal inadequacy (Dweck & Leggett, 1988). Students with a mastery-oriented reaction to failure exhibit sustained or improved performance after experiencing failure, whereas students with a compliance mindset exhibit deteriorating performance after experiencing failure (Dweck & Reppucci, 1973).

Another step in promoting students' ownership of learning is helping them establish *learning goals* as opposed to *performance goals* (Dweck & Sorich, 1999) Learning goals cause individuals to seek to increase their ability to master new tasks and to emphasize understanding and growth whereas performance goals cause individuals to seek to prove, validate, or document their ability and avoid discrediting it or calling it into question. Learning goals have been shown to improve students' problem solving, exam grades, course grades, processing of course material, achievement test scores, and intrinsic motivation (Dweck & Sorich, 1999; Grant & Dweck 2003; Kaplan & Maehr, 1999; Meece & Holt, 1993; Midgely & Urdan, 1995; Roeser, Midgely, & Urdan, 1996). When learning goals are highlighted, students' beliefs about their abilities are not constraints to achievement, children of both high and low belief in their abilities seek to increase their competence when they adopt a mastery oriented mindset (Eliot & Dweck, 1988). Further, specific, challenging goals lead to higher performance than easy *do-your-*

best goals, or no goals at all (Locke, Shaw, Saari, & Latham, 1981). Self-direction is promoted through novel and complex work, classes that emphasize the importance and benefits of obtaining new knowledge and skills encourage students to set mastery goals rather than performance goals (Bronfenbrenner, 1979; Csikszentmihalyi, 1984, 1990; Dweck & Leggett, 1988; Grant & Dweck, 2003).

The third element of Conley's (2014) student ownership of learning model is *self-efficacy.* Self-efficacy and self-confidence or self-concept are different in that "self-efficacy is a context-specific assessment of competence to perform a specific task" whereas self-concept or self-confidence are beliefs in ability and self-worth that are not context-specific (Pajares & Miller, 1994, p. 194). Self-efficacy involves individuals' notion that they are able to exercise influence and control over their behavior (Bandura, 1977, Locke & Latham, 1990). Students who attribute their academic success to their own ability and effort and who do not attribute failure to lack of ability tend to have higher academic skills and higher academic self-concepts (Bandura, 1997, Marsh, 1984). Student self-efficacy is related to engagement and performance on academic tasks, college performance, college retention, and career success measured by salary and status (Abele & Spurk, 2009; Richardson, Abraham, & Bond, 2012; Robbins, et al., 2004; Schunk, 1981; Zimmerman, 1989; Zimmerman, Bandura, Martinez-Pons, 1992).

Like students with a mastery-oriented mindset, students with high self-efficacy value learning over looking smart and respond to academic setbacks by increasing effort or trying new strategies (Dweck, Walton, Cohen, 2011). Greater self-efficacy also leads to greater motivation and perseverance in challenging scenarios (Schunk, 1982; Zimmerman, Bandura, Martinez-Pons, 1992). In a study investigating the effects of self-

motivational factors of students' academic achievement, perceived self-efficacy for academic achievement and student goals accounted for 31% of the variance in students' grades (Zimmerman, Bandura & Martinez-Pons, 1992). In addition, the researchers found that the influence of students' prior grade attainment on current attainment was mediated by self-regulatory factors. Goal setting was key to students' attainment of grade goals—the higher the perceived self-efficacy, the higher the goals, and self-efficacy influenced the achievement of those goals.

Educators can help students develop self-efficacy by facilitating performance accomplishments, which are successes that reinforce efficacy expectations and promote self-efficacy (Bandura, 1977). These performance accomplishments help to minimize individuals' anxieties around learning and the self-efficacy that they help develop will transfer to other scenarios and enable the individual to counter anxiety from past failures (Bandura, 1977). The type of feedback that educators give also affects students' self-efficacy: past attributional feedback that acknowledges students' past hard work leads to greater improvement than future attributional feedback that tells students that they need to work harder (Schunk, 1982).

Central to the notion of taking ownership is awareness of and involvement in the learning process through *progress monitoring* and *help seeking* (Conley, 2014). This involves actively participating in the learning process and reflecting on that participation through metacognition and self-monitoring. Like the other student ownership of learning factors discussed here, metacognition and self-monitoring have small to medium sized relationships with outcomes such as K-12 student achievement, college student GPA, and

college retention (Credé & Kuncel, 2008; Lindner & Harris, 1998; Marzano, Gaddy & Dean, 2000; Richardson, Abraham, & Bond, 2012).

Metacognition involves both self-reflection about cognition and the regulation of cognition through the development of strategies (Vrugt & Oort, 2008). As discussed, when students pursue learning or mastery goals, the emphasis is on developing a deep understanding of the material. This process is not about demonstrating what the student already knows, as in the pursuit of performance goals. Instead, it is about the student engaging with material and persisting in the face of challenge. This process of engagement in learning leads to greater metacognition because students reflect on what they are learning and develop learning strategies based on that self-reflection (Ames, 1992; Vrugt & Oort, 2008). Students who can recognize when they are not being effective learners and who adapt their approach accordingly avoid making the same mistakes repeatedly or approaching tasks mindlessly.

Conley's (2014) conceptualization of *persistence* is related to but different from resilience (Luthar, Cicchetti & Becker, 2000; Rutter, 2006), and also encompasses grit (Duckworth, Peterson, Matthews & Kelly, 2007) and academic tenacity (Dweck, Walton & Cohen, 2011). The body of literature around the construct of resilience has focused for the most part on individuals who have endured tremendous hardships such as having parents who are mentally ill or on drugs, experiencing catastrophic life events, living in violent inner city environments, and other adversities (Garmezy & Tellegen, 1984; Luthar, 1991; Luthar, Cicchetti & Becker, 2000; Masten, Best, & Garmezy, 1990; Rutter, 2006). While researchers in this area assert that resilience is not a fixed personality trait, the individuals who develop resilience are those whose particular life circumstances have

forced them to become adaptable in the face of significant adversity (Luthar, Cicchetti & Becker, 2000). By this definition, individuals who have not faced adversity cannot demonstrate resilience.

Grit (Duckworth, Peterson, Matthews & Kelly, 2007) and academic tenacity (Dweck, Walton & Cohen, 2011) both involve sustained hard work towards a goal. These constructs differ from resilience in that they do not require the individual to face significant adversity. Rather, they are mindsets that foster persistence in the face of challenge. Grit and academic tenacity are tied to gains in student achievement, as is conscientiousness (Duckworth, Peterson, Matthews & Kelly, 2007; Duckworth & Quinn, 2009; Dweck, Walton & Cohen, 2011). However, grit and tenacity differ from conscientiousness in that they go beyond self-control or the deferral of immediate gratification and involve the passion for long-term goal obtainment (Duckworth, Peterson, Matthews & Kelly, 2007; Dweck, Walton & Cohen, 2011). Students with high self-control but low grit are not as successful: students need both self-control and grit to sustain hard work (Duckworth & Quinn, 2009; Duckworth, Peterson, Matthews & Kelly, 2007).

Persistence can be developed systematically and mastered by all students. It does not require experiencing adversity, although it is a particularly powerful skill for students experiencing adversity to have. At the heart of persistence is the passion for a goal and the ability to self-regulate to achieve that goal (Conley, 2014). Students with persistence control their own learning, overcome obstacles on their own, and know when to seek help. They believe that most everything worthwhile—particularly learning—takes time and effort, and they value working hard as well as working "smart" (Dweck, Walton &

Cohen, 2011). Students with persistence have a mastery-oriented mindset, have specified learning goals, and have developed the self-control to defer immediate gratification to pursue those learning goals (Dweck, Walton & Cohen, 2011). Students with persistence have the mindset to overcome challenges; these students see failure differently than those with low persistence and a fixed mindset.

Learning Skills. The Key Learning Skills and Techniques dimension also contains *Learning Skills* such as test taking, note taking, and time management. In a metaanalysis of effective instructional strategies, large relationships were observed between K-12 success and learning skills such as summarizing and note taking, homework and practice, and cooperative learning (Marzano, Gaddy, & Dean, 2000). At the college level, academic-related skills, study habits, study skills, and time/study management had small and medium sized effects on college outcomes like GPA and retention (Credé & Kuncel, 2008; Richardson, Abraham & Bond, 2012). Many careers also require workers to stay current with advancements in their field, thus workers need the skills to learn information long after they leave school (Gettinger & Seibert, 2002).

For example, technical advancements in the automotive industry have required mechanics to learn skills that were not relevant 20 years ago. In order to stay abreast of current fields in the car industry, mechanics must be able to access, interpret, and retain information and this process is enhanced through techniques such as note taking, reading strategies, and memorization and recall. At the K-12 level, instruction on study skills had a strong effect on students' academic achievement and these effects were enhanced when study skills were taught in combination with content rather than taught in isolation in

study skills programs (Hattie, 2009). Further, these strategies had a greater effect on the achievement of low performing students than higher achievers (Hattie, 2009).

Hattie, et al. (1996) contend that the most effective study skills training is conducted within the context of the subject matter and promotes metacognition: "the student needs to know various strategies that are appropriate to the task at hand: the how, when, where, and why of their use" (Hattie, 2009). Strategies that require the learner to actively participate in learning have the strongest effects on student achievement, for instance organizing and transforming, or the process of rearranging instructional materials to improve learning, has a large effect on student achievement, as do self-instruction and self-evaluation (Hattie, 2009). Particularly effective strategies are those that require forward thinking such as goal setting and planning (Hattie, 2009). Other effective strategies include the awareness of textual inconsistency and the use of self-questioning (Haller, Child, and Walberg, 1988).

As with the other parts of the Four Keys, the *Learning Skills* overlap with and enhance the other Keys in that they facilitate the acquisition of cognitive skills and content knowledge and require students to engage with and own their learning (Conley, 2014; Gettinger & Seibert, 2002; Farrington, et al., 2012). Further, these skills are highly personal and require students to be self-aware enough to employ the appropriate strategies to address their own unique strengths and weaknesses. The use of learning skills requires the self-discipline to study outside of school and the self-regulation to adapt strategies to the task at hand (Gettinger & Seibert, 2002). There is empirical support for the inclusion of KLST in a college readiness model: related dispositions,

skills, and instructional strategies have relationships with K-12 achievement and college GPA (Table 2.8).

Table 2.8

Effects of Constructs Related to Key Learning Skills and Techniques on K-12 Achievement and College GPA

Construct (authors)	Effect	*n*
Academic-Related Skills (Richardson, Abraham & Bond, 2012)	0.13*	16,282
Time/Study Management (Richardson, Abraham & Bond, 2012)	0.22*	5,847
Academic Self-Efficacy (Richardson, Abraham & Bond, 2012)	0.31*	46,570
Metacognition (Richardson, Abraham & Bond, 2012)	0.18*	6,205
Study Habits (Credé & Kuncel, 2008)	0.23*	23,390
Study Skills (Credé & Kuncel, 2008)	0.25*	25,547
Study Attitudes (Credé & Kuncel, 2008)	0.22*	5,847
Study Motivation (Credé & Kuncel, 2008)	0.23*	6,157
Metacognitive Skills (Credé & Kuncel, 2008)	0.18*	1,915
Summarizing & Note Taking (Marzano, Gaddy & Dean, 2000)	1.0**	179 studies
Cooperative Learning (Marzano, Gaddy & Dean, 2000)	0.73**	122 studies
Homework and Practice (Marzano, Gaddy & Dean, 2000)	0.77**	134 studies

*Relationship with college GPA; **Relationship with K-12 achievement

Key Transition Knowledge and Skills. The *Key Transition Knowledge and Skills* are the information and behaviors necessary to understand the norms, culture, expectations, and systemic processes for gaining entrance into and navigating the postsecondary environment that aligns to one's career or academic aspirations (Conley, 2014). The elements outlined in the Key Transition Knowledge and Skills are intended to address the contextual, procedural, financial, cultural, and personal issues associated with the transition from high school to college and careers (Conley, 2014). For instance, the contextual information required to align students' interests and aspirations with college entrance requirements and the qualifications required to enter careers are articulated through the *Postsecondary Awareness* and *Career Awareness* aspects of the Key. The procedural and financial knowledge of how to apply and pay for college are articulated in

the *Matriculation* and *Postsecondary Costs* aspects. The cultural information around the behavioral norms expected of students entering college and the workforce are articulated in the *Role and Identity* aspect, and the personal information around how to navigate campus bureaucracy and other challenges is articulated in the *Self-Advocacy* aspect. See Table 2.9 for these aspects, components, and their definitions.

Table 2.9

Key Transition Knowledge and Skills: Aspects, Components, and Definitions

Aspect	Component
Role & Identity: Anticipate and be prepared for changing roles and expectations.	**Role Identity:** While in school, maintain a primary identity as a student scholar; secondary identities are encouraged for personal development (e.g., musician or band member).
	Role Conflict: Minimize identifying with roles that conflict with being a student scholar (e.g., gang member); anticipate adaptions in role necessary to respond to changes in status and behaviors expected during transition (e.g., going from having seniority in high school to being a freshman again).
	Role Models: Access and establish relationships with role models who have successfully made postsecondary or career transitions similar to those being aspired to.
Self-Advocacy: Be aware of resources available to support goals and know when to seek them out.	**Resource Acquisition:** Become familiar with institutional resources needed to manage the emotional, social, and procedural aspects of the postsecondary environment one aspires to (e.g., writing center, health center, social organizations).
	Institutional Advocacy: Navigate the institutional structures and persist to effectively overcome procedural and logistical challenges.

Table 2.9

Key Transition Knowledge and Skills: Aspects, Components, and Definitions (Cont.)

Aspect	Component
Postsecondary Awareness: Know that being successful in high school requires different skills than it does to be successful in college or the workplace.	**Postsecondary Aspirations:** Establish specific goals for after high school and continually evaluate the alignment between aspirations, qualifications, and evolving skills and interests.
	Postsecondary Norms & Culture: Understand the norms and culture of the postsecondary environment to which one aspires.
Postsecondary Costs: Know how much college costs, as well as how much not going to college costs, and be able to identify and access financial aid.	**Tuition Awareness:** Understand the range of tuition costs for different types of institutions including community colleges versus four-year colleges, in-state versus out-of-state colleges, public universities versus private colleges, etc.
	Financial Aid Awareness: Understand the processes and supports available to reduce the costs associated with postsecondary education and training, and the requirements for eligibility and application.
Matriculation: Learn about the college admissions process and have the knowledge, skills, and persistence needed to get into college.	**Postsecondary Eligibility:** Be familiar with the entrance/eligibility requirements for postsecondary training or education; continually evaluate and improve fit between aspirations and eligibility requirements.
	Admissions Procedures: Know the timeline, requirements, and deadlines for the application and admissions process; be familiar with the evaluation criteria and have a plan for how to maximize the chances of success.
	Program Selection: Understand the differences between types of programs and which one is best suited to attaining postsecondary aspirations.
Career Awareness: Possess insight into individual strengths and weaknesses and how to explore and align those with the numerous career options available.	**Career Options:** Explore available options, preferably first-hand, for careers and workplaces that maximize one's skills and current qualifications.
	Career Requirements: For the career options explored, understand the differences in entry-level educational requirements, training, pay grade, benefits, and working conditions.
	Career Readiness: Develop and maintain a realistic awareness of the alignment between strengths and weaknesses, academic qualifications, and desired career requirements.

Note: Adapted from Conley (2012, 2014)

Central to the Four Keys in general and specifically the Key Transition Knowledge and Skills is the integration of students' aspirations for after high school with their preparation for achieving those goals. Encouraging students to establish high educational aspirations can help ensure that students will pursue postsecondary education. Educational aspirations are strongly related to college enrollment, retention and GPA (Cooper, 2009; Richardson, Abraham & Bond, 2012; Robbins, et al., 2004). Students who aspire to obtain college degrees are 28% more likely to apply to and attend college than students with no aspirations to attend college (Cabrera & La Nasa, 2001).

Despite this connection between aspirations and educational attainment, studies indicate a persistent aspirations slump in American public schools. Eighty-eight percent of eighth grade students reported that they aspired to attend college on the National Educational Longitudinal Study (NELS, Venezia, Kirst, & Antonio, 2003). Of students in the NELS who had obtained college qualifications such as the requisite GPA, class rank, aptitude test scores, SAT and ACT scores, only 69% enrolled in college whereas only 9% of unqualified students enrolled (Cabrera & La Nasa, 2001). In a study that examined students' background characteristics in relation to student post-secondary aspirations for a sample of 5,308 students, high school cumulative GPA was the strongest predictor of all aspirations examined (Gilkey, Seburn & Conley, 2011). Students who did well academically were more likely to aspire to college.

Race also influences the relationship between college aspirations and attendance (Bennett & Xie, 2000, Perna, 2000, Solozorano, 1991). A smaller proportion of African American students aspired to obtain a college degree than White students and, of the students who aspired to earn a BA, larger proportions of White students than African

American students actually enrolled in college (Bennett & Xie, 2000). Aspiring to an advanced degree had a positive influence on college enrollment rates for Hispanic/Latino students and White students but was unrelated to enrollment for African American students (Perna, 2000). When controlling for SES, African American students had higher educational aspirations than students from other ethnic groups (Solozorano, 1991). Students from both ethnic groups valued education similarly, yet the likelihood of African American students attending college was 43% lower than White students (Solozorano, 1991). When controlling for gender, costs, benefits and financial resources, Latino students were less likely than White students to enroll in college, yet African American students were as likely as White students to enroll (Perna, 2000). These racial gaps are also reflected in college remediation rates. More than one third (36%) of incoming four-year college students enrolled in remedial courses with 45% of African American students and 43% of Hispanic/Latino students enrolling (Aud et al., 2011).

In addition, the aspirations of students whose parents did not attend college tend to be lower than those of students whose parents had a bachelor's degree (Choy, 2001). For example, in the class of 2010, 46% of students whose parents who had not attended college had definite plans to graduate from a four-year college, whereas 57% of students whose parents had attended college planned to graduate, 66% of students whose parents had earned a BA planned to graduate, and 78% of students whose parents had earned a graduate or professional degree planned to graduate from a four-year college (Aud et al., 2012). This difference by parents' background has persisted since 1990, however the gaps have narrowed in that time: in 1990 the difference between students' plans to graduate for students whose parents had not attended college versus students whose

parents had earned graduate or professional degrees was 40% but in 2011 there was a 32% difference (Aud et al., 2012).

One potential explanation for these differences is that the information available to first-generation students may not come from their parents. These students will rely on teachers, guidance counselors, college recruiters, and their peers for information about enrolling and attending college. Further, this information must be made available in middle school because most students formulate their plans to attend college in eighth or ninth grade (Hossler & Schmit, 1995). As discussed, the majority of eighth grade students aspire to attend college, however most of these aspiring students will not attend and graduate (Venezia, Kirst, & Antonio, 2003). This may be due to a lack of academic preparation and first generation college students tend to be less academically prepared than their peers whose parents did attend college (Choy, 2001). However, the difference in college intentions made by parents' education was evident for highly achieving students as well, in 1994 92% of highly achieving students whose parents had attended college planned to attend versus 76% of highly achieving first-generation students (Choy, 2001).

Despite these grim statistics, parental education made no difference in attendance rates for students who took the steps to enroll in a four-year college or university (Choy, 2001). These steps include preparing academically, taking college admissions tests, and submitting application materials. Unfortunately, taking these steps is more difficult for first-generation students, these students tended to receive less parental assistance with the matriculation process than students whose parents attended college and first-generation students tend to have limited access to information about this process (Choy, 2001;

Thayer, 2000). First generation students, students from low-SES backgrounds, and African American and Latino/Hispanic students tend to have limited access to information about financial aid and tend to overestimate tuition rates (Bell, Rowan-Kenyon & Perna, 2009).

This lack of knowledge about what to do to be college eligible is a roadblock for all students who aspire to college but do not attend (Cabrera & La Nasa, 2001). There was a significant difference between eleventh and twelfth grade students' academic goals and their understanding and awareness of how to transition into college as measured by the CampusReady survey (Gilkey, Seburn, Conley, 2012). In that study, students who aspired to attend a four-year college after high school had significantly higher mean scores on the Key Transition Knowledge and Skills subscales than students who planned to attend 2-year college, work or those who did not have post-high school plans. For example, on CampusReady items measuring students' *College Awareness* (how to make the transition to college, the differences between high school and college, and types of colleges and fields of study), students who aspired to attend four-year college had higher scores than students who did not have post-high school plans.

In other words, students who aspired to go to college rated themselves higher on items that measured their awareness of and preparation for college than other students. At the same time, Gilkey, et al. (2012) found that students who planned to work after high school had lower scores than students who planned to attend college (in the *Career Awareness* subscale. These results indicate that students who plan to work after high school may not be doing so because they understand how to develop a resume participate in an internship, and enter and succeed in the career that interests them. Because Gilkey

et al. (2011) found that GPA was the strongest predictor of college aspirations; it may also be that students who plan to work believe they lack other options.

There is empirical support for the inclusion of KTKS in a college readiness model: related dispositions, skills, and instructional strategies have small to moderate relationships with K-12 achievement and college GPA (Table 2.10).

Table 2.10

Effects of Constructs Related to KTKS on College GPA

Construct (authors)	Effect	*n*
Goal Commitment (Richardson, Abraham & Bond, 2012)	0.15	13,098
Institutional Commitment (Robbins, et al., 2004)	0.11	5,775
Financial support (Robbins, et al., 2004)	0.20	6,849
Academic Goals (Robbins, et al., 2004)	0.16	17,575
Perceived Social Support (Robbins, et al., 2004)	0.10	12,366
Social Involvement (Robbins, et al., 2004)	0.12	15,955
Achievement Motivation (Robbins, et al., 2004)	0.26	9,330

Assumption Two: CampusReady Measures the Four Keys

As discussed, the first assumption underlying CampusReady score interpretation is that the Four Keys model contains the constructs associated with success in college and careers. The second assumption underlying CampusReady score interpretation is that CampusReady measures the Four Keys. Basic to this assumption are technical inferences and the inference of observation, or that "the score results from an instance of the measurement procedure" (Kane, 1992, p. 529). First, this section describes CampusReady development, administration, and scoring procedures and presents the evidence on the degree to which CampusReady items accurately measure the constructs they are intended to measure. This evidence is procedural and descriptive and alone this evidence is not enough to support an interpretive argument because if procedural evidence is weak, it "can be decisive in refuting an interpretive argument" (Kane, 1992, p. 529). As this

section demonstrates, the procedural evidence supporting CampusReady is sound and does not refute the validity argument for CampusReady because CampusReady development followed best practices. Next, this section presents evidence from two studies in which factor analysis was conducted on CampusReady items. These studies indicated that CampusReady items group around the Four Keys model structure for the Key Cognitive Strategies and the Key Learning Skills and Techniques (Lombardi, Conley, Seburn, & Downs, 2013; Lombardi, Seburn, & Conley, 2011a).

CampusReady Development

Test development begins with the specification of the test's purpose (AERA, APA, NCME, 2009). After test developers specify the purpose of a test, the *Standards* recommend four general steps that test developers should take, depending on the purpose of the test (AERA, APA, NCME, 2009). First, test developers should specify the "scope of the construct" being measured (AERA, APA, NCME, 2009, p. 37). This construct specification is an essential step, the constructs of interest should drive the design of the test and items and scoring criteria should be developed around revealing those constructs (Messick, 1994; Mislevy, Almond, & Lukas, 2004). The second step in test development is the creation of test specifications that guide all subsequent development because they "delineate the format of items, tasks, or questions; the response format or conditions for responding; and the type of scoring procedures" (AERA, APA, NCME, 2009, p. 38). The third step is development and field-testing, and the last step in this process is the production of the test for operational use.

As demonstrated in this section, the Educational Policy Improvement Center (EPIC) followed this cycle when developing CampusReady. First, EPIC determined the

purpose of CampusReady, which is to measure the degree to which schools are preparing students for college and career readiness. Next, EPIC specified that CampusReady would measure the constructs contained in the Four Keys model. Test specifications were documented and followed as the tool was developed, piloted, and launched for operational use. Although the details of the development of CampusReady are beyond the scope of this study, EPIC's apparent adherence to the recommendations outlined in the *Standards* and other best practices lends procedural validity evidence supporting the notion that CampusReady is an accurate measure of the Four Keys.

Item specification and development. EPIC developed CampusReady to measure the Four Keys model through several rounds of refinement (Educational Policy Improvement Center, 2013). After Conley developed the Four Keys model, he and EPIC researchers further refined and operationalized each of the Four Keys into aspects and components and created definitions of each of these aspects and components. EPIC then developed subscales of items for administrators, counselors, teachers, and students that were designed to measure the components of the Four Keys and their definitions.

Piloting and item revision. Panels of college professors, high school teachers, and five administrators and counselors from the schools who participated in the CREST project on which the Four Keys was based reviewed and provided feedback on the first draft of the items (Educational Policy Improvement Center, 2013). After incorporating the results from field-testing, EPIC piloted CampusReady during the 2009-10 academic year. EPIC collected user feedback on the items and the instrument overall through the online tool and conducted site visits and focus groups at pilot schools (Educational Policy Improvement Center, 2013). During the focus groups, EPIC elicited participants'

feedback on the items, the technology of the tool, and user materials. EPIC incorporated this feedback into revised items. EPIC also refined response options for each user group and subscale through several rounds of revision and field-testing.

According to the *Standards*, tests should be revised if "new research data, significant changes in the domain, or new conditions of test use and interpretation would either improve the validity of interpretations of the test scores or suggest that the test is no longer fully appropriate for its intended use" (AERA, APA, NCME, 2009, 42). Once CampusReady's pilot phase ended, EPIC began to review and revise items annually in response to user feedback and item analysis (Educational Policy Improvement Center, 2013). Further, Conley has revised the Four Keys model as new findings emerge around college and career readiness. As a result, the CampusReady items have been revised five times since 2009. The latest revision was in the summer of 2013, this revision cut down the number of items administered to students and teachers and revised the language complexity of student items in response to user feedback the tool was taking too long to administer and that the language was too difficult for students, particularly English Language Learners. In addition, EPIC significantly revised the items in the Key Content Knowledge subscales.

The present study used data collected prior to the 2013 item revision. This revision should not impact these findings for the Keys that were not significantly revised, however, the revisions to the Key Content Knowledge items place limits on the findings for that Key.

Report development. EPIC launched CampusReady's online reporting system in the fall of 2010 (Educational Policy Improvement Center, 2013). Reports display CampusReady results at the school level in reports displaying the frequency of users selecting each response category for each item; Key-, aspect-, and component-level reports displaying average scores for each user group; and recommendations for improvement generated by each school's results. These reports can be filtered by teacher and student characteristics. The reports were piloted and revised in 2011 based on user feedback. In the fall of 2013, EPIC began offering student-level reports containing students' scores on each Key, aspect, and component as well as recommendations tailored to their results.

Administration. Although schools are responsible for administering CampusReady, EPIC provides schools with guidelines for standardized administration procedures (Educational Policy Improvement Center, 2013). Schools administer CampusReady over three weeks to a representative sample of students and all administrators, counselors, and core content teachers. For schools with more than 400 students, EPIC trains and supports school liaisons in the identification and selection of a representative sample of students, 100 from each grade, to take CampusReady. For schools with fewer than 400 students, EPIC asks schools to administer CampusReady to all students in the school. Before CampusReady administration, schools obtain consent from the parents of participating students as specified under the Family Educational Rights and Privacy Act (1997). Responses from all users are confidential and results from subgroups of fewer than five students are hidden to protect student privacy.

Scoring. Some CampusReady items elicit yes or no responses or categorical responses, but most of the items administered to students use a likert-type scale with five response options: *Not at all like me, a little like me, somewhat like me, a lot like me, very much like me.* This scale ranges from 1 (*not at all like me*) to 5 (*very much like me*). In computing students' scores, CampusReady's online reporting system averages students' responses to items on this scale across items within components, aspects, Keys, and then across users.

Factor Analysis

As demonstrated, CampusReady development, administration, and scoring procedures support the assumption that CampusReady measures the Four Keys because EPIC followed best practices in developing and maintaining CampusReady. In addition to this procedural evidence, there is limited empirical support for the assumption based on the results of two exploratory and confirmatory factor analyses conducted on CampusReady (Lombardi, Conley, Seburn, Downs, 2013; Lombardi, Seburn, & Conley, 2011a). Results indicated that the Key Cognitive Strategies (KCS) items grouped in a five-factor structure that was consistent with the structure of the KCS however the Key Learning Skills and Techniques (KLST) items did not group as well as the KCS items (Lombardi, Conley, Seburn, Downs, 2013; Lombardi, Seburn, & Conley, 2011a). The factor scores for the KLST items differed by student gender and race for ninth grade students, however there were no differences among student subgroups for tenth through twelfth grade students.

Assumption Three: CampusReady Scores Are Generalizable Across Samples of Items, Scorers, and Occasions

Reliability Evidence

Reliability analyses to examine the internal consistency of the subscales using Cronbach's α (alpha) resulted in reliability coefficients clustering in the acceptable range, around 0.80, for most subscales. See the Appendix for the results of the reliability analyses on the 2012-13 high school student subscales.

Assumption Four: CampusReady Scores Are Free of Sources of Systematic Error That Would Bias Interpretation of Scores as Indicators of Student College and Career Readiness

The second, third, and fourth research questions explored in this study were designed to provide evidence of the consequential validity of CampusReady by examining the differences in CampusReady scores based on students race/ethnicity, mothers' education, and first language. This section discusses the role of consequential evidence in validity studies and the potential risks and benefits of using CampusReady scores to make decisions about students.

Consequential-related Evidence

Experts in the field of assessment do not agree on the role of test consequences in a validity argument (Kane, 2001; Mehrens, 1997; Messick, 1998; Popham, 1997). On one side of the debate are scholars like Popham (1997) who argue that consequences of testing, while important, should not be considered in validity arguments. On the other side of the debate are scholars like Messick (1998) who argue that the consequences of testing should play a central role in a validity argument. One concern proposed by

scholars in the first camp is that the validity of an instrument should not rely on how that instrument is used or misused. In an example proposed by Mehrens (1997), a thermometer is used to read a patient's temperature and the physician infers from the thermometer that the patient has a fever. Mehrens (1997) argues that the validity of the thermometer in reading temperatures is not related to the treatment plan created by the physician based on the results. Applying this reasoning to education, Mehrens (1997) states:

> The accuracy of an inference about the amount of some characteristic an individual has is separable from the efficacy of any treatment (or the wisdom of any action). While one can call them both validity, it seems unwise to do so (p. 17).

In other words, these scholars argue that the ways test results are used for decision-making are not functions of the validity of the test. Part of this argument is that test developers have little control over the misuse of test results and often the consequences of test use cannot be determined until long after the test is in operational use (Mehrens, 1997).

The other side of this debate argues that, although misuse of test scores should be kept separate from the validity argument, consequences of legitimate use should be considered in a validity argument, particularly when subgroups of examinees score differently. Scholars on both sides of the debate agree that while developers should do their best to evaluate and mitigate the potential consequences of testing, the validity of the test should not hinge on consequences resulting from misuse of the test but that the "unanticipated side effects of *legitimate* test use" should be considered "especially if

unanticipated adverse effects are traceable to sources of test invalidity such as construct underrepresentation and construct-irrelevant difficulty" (Messick, 1998, p. 40).

Thus, the validity of test score interpretation may be compromised when the test results differ based on the characteristics of examinees because those differences may be due to an element of the assessment that is measuring something other than the intended construct. For example, when the results of a math test differ based on students' proficiency in English, test items should be evaluated to ensure that those differences are based on true differences in student math abilities, rather than their proficiency in English.

According to the *Standards*, when subgroup differences occur in testing, efforts should be made to determine if those differences are attributable to either *construct underrepresentation* or *construct irrelevant variance* (AERA, APA, & NCME, 1999). Construct underrepresentation, is when "the assessment is too narrow and fails to include important dimensions or facets of the construct" (Messick, 1995, p. 742). Construct underrepresentation threatens test validity when low scores occur "because the assessment is missing something relevant to the focal construct that, if present, would have permitted the affected persons to display their competence" (Messick, 1995, p. 746). Construct irrelevant variance, on the other hand, is where "the assessment is too broad," this threat to validity can take two forms: *construct irrelevant-difficulty* and *construct-irrelevant easiness* (Messick, 1995, p. 742). This threatens validity when low scores occur "because the measurement contains something irrelevant that interferes with the affected persons' demonstration of competence" (Messick, 1995, p. 742). Where subgroup differences do exist, the next step is to examine the source of subgroup

difference in order to determine if they were due to either construct underrepresentation or construct irrelevant variance, “such research should seek to detect and eliminate aspects of test design, content, and format that might bias test scores for particular groups” (AERA, APA, & NCME, 1999, p. 81).

In this study, research questions two through four addressed this concern by examining the differences in CampusReady scores based on students’ race/ethnicity, mothers’ education, and first language in order to determine the effect of those characteristics on CampusReady scores. Results of these analyses are presented in chapter four.

Assumption Five: Students with Higher CampusReady Scores Are More Prepared for College and Careers

Finally, the fifth assumption underpinning the use of CampusReady scores as indicators’ of student college and career readiness is that there is a relationship between students’ scores and their preparation for college and careers. The fifth and sixth research questions in this study addressed this assumption by examining the relationships between students’ CampusReady scores and their GPA and their aspirations for after high school. This type of evidence, or *criterion-related evidence,* is used to demonstrate the relationship between test scores and the behavior the test purports to measure (Messick, 1990). As discussed in the following sections, such evidence can come from examining the relationships between test scores and either *predictive* or *concurrent* criteria.

Criterion-related Evidence

Predictive validity evidence. Predictive validity "indicates the extent to which an individual's future level on the criterion is predicted from prior test performance" (Messick, 1990, p. 7). In the case of CampusReady, predictive validity evidence would demonstrate the relationships between students' CampusReady scores and their success in college and the workplace. For example, longitudinal studies that track students after they have taken CampusReady would demonstrate the predictive validity of CampusReady if students who scored higher on CampusReady also had higher grades in college, lower remediation rates, higher graduation rates, and higher job performance ratings.

Concurrent validity evidence. Concurrent validity evidence "indicates the extent to which the test scores estimate an individual's present standing on the criterion" (Messick, 1990, p. 7). In the case of CampusReady, this evidence would demonstrate the relationships between CampusReady scores and concurrent measures of college and career readiness such as their high school grades, graduation rates, state assessment scores, or college admissions test scores. The fifth and sixth research questions in this study are designed to explore the concurrent validity evidence that there is a relationship between student CampusReady scores and their aspirations for after high school and grade point average.

Overview of Assumptions

In summary, I framed five assumptions underlying CampusReady score interpretation around the criteria six categories of inferences outlined by Kane (1992): theory-based inferences, observation, technical inferences, generalization, decision-based inferences, and extrapolation, as summarized in Table 2.11. The next chapter discusses the methods used to address the research questions designed to explore the fourth and fifth assumptions.

Table 2.11

Categories of Inference, Assumptions, and Evidence Supporting CampusReady Score Interpretation

Inferences	Assumptions	Evidence
Theory-based	1. The Four Keys model contains the skills and dispositions associated with success in college and careers.	Historical, contextual, theoretical and empirical support for the inclusion of metacognitive learning skills in college and career readiness models and for the Four Keys model.
Observation-based and Technical	2. CampusReady measures the Four Keys.	Procedural and descriptive summary of CampusReady development, administration, and scoring procedures and evidence from factor analysis of CampusReady items indicate that CampusReady measures the Four Keys.
Generalization	3. CampusReady scores are generalizable across samples of items, scorers, and occaisions.	Reliability statistics are strong for CampusReady subscales ($\alpha = 0.70$ to 0.92).
Decision-based	4. CampusReady scores are free of sources of systematic error that would bias interpretation of scores as indicators of students' college and career readiness.	Research questions two through four explore preliminary evidence of the effects of race/ethnicity, mothers' education, and first language on student CampusReady scores.
Extrapolation	5. Students with higher CampusReady scores are more prepared for college and careers and vise versa.	Research questions five and six explore preliminary evidence of the relationships between student CampusReady scores and their aspirations for after high school and GPA.

CHAPTER III

METHODOLOGY

This chapter presents the methods used to address the research questions including information about the schools and students who participated in CampusReady in the 2012-13 administration. After describing the differences between the overall sample and the subsample of student data used for analyses, the chapter presents descriptive statistics for the analytic subsample overall and by grade for the characteristics explored in this study including scores, grade point average, background characteristics, and aspirations for after high school. This chapter concludes with an overview of the analyses and statistical methods used to address the research questions.

Schools

Nineteen schools participated in the 2012-13 CampusReady administration. School size ranged from 72 to 3,183 students (Table 3.1). These schools were located in nine states: Texas, Oregon, New York, Washington, Connecticut, Kansas, Pennsylvania, Ohio, and Missouri. Twelve of the 19 schools were Title I schools, and these schools contain higher-than average rates of students eligible for Free or Reduced Price Lunch (FRPL). These schools also contain more Hispanic/Latino students than average.

When schools participate in a standard CampusReady administration, EPIC requests that schools administer the survey to a representative sample of students of no fewer than 100 students per grade. When schools have fewer than 100 students per grade, EPIC requests that the school administers CampusReady to all students in the school. Table 3.1 displays the demographics of participating schools and the percent contribution of students from each school to the subsample used for analyses.

Table 3.1

Participating School Demographics

School	Total Students	Students Completed CR	% of Analytic Subsample	State	Title I School	% FRPL	% Female	% Asian or Pacific Islander	% African American	% American Indian/Alaskan Native	% Hispanic/ Latino	% White	% Multiple Categories/Mixed Race
1*	3,183	20	0.4	TX	Yes	71.6	49.0	0.9	2.7	0.2	89.8	5.6	0.8
2	374	295	6.3	OR	No	78.3	48.1	1.1	1.9	3.2	12.0	81.8	0.0
3*	1,022	113	2.4	TX	Yes	42.9	49.9	0.2	1.1	0.1	57.8	39.1	1.7
4†	520	183	3.9	NY	Yes	98.5	47.1	3.5	84.8	1.3	9.2	1.2	0.0
5*	1,626	438	9.4	OH	Yes	68.0	48.2	1.8	26.9	0.1	2.3	62.1	6.8
6	1,079	388	8.3	WA	Yes	39.8	47.3	21.0	5.3	0.6	18.3	48.7	6.2
7	1,824	393	8.5	OR	Yes	84.9	47.8	7.4	1.8	1.2	61.0	25.3	3.4
8	1,734	532	11.4	CT	No	54.3	48.6	5.9	34.3	0.2	39.2	19.8	0.5
9	292	204	4.4	OR	No	--	57.9	3.4	1.0	0.7	7.2	85.6	2.1
10*	175	63	1.4	TX	Yes	48.0	59.4	0.0	3.4	0.0	22.3	73.1	1.1
11	548	369	7.9	PA	No	31.0	48.4	0.7	0.7	0.2	3.6	90.0	4.7
12*	1,501	34	0.7	TX	No	15.8	48.2	2.5	2.0	0.6	34.2	60.2	0.4
13	839	617	13.3	MO	Yes	76.0	47.4	1.2	14.2	0.5	19.7	62.1	2.4
14*†	430	166	3.6	TX	Yes	91.9	50.7	0.2	0.7	0.2	95.1	3.5	0.2
15	1,223	410	8.8	KS	Yes	94.7	49.8	9.4	34.7	0.2	47.8	7.4	0.4
16*	1,947	66	1.4	TX	Yes	--	47.5	0.1	0.4	0.0	98.1	1.3	0.1
17	165	119	2.6	OR	No	71.5	50.9	0.0	0.6	1.2	4.8	92.7	0.6
18	72	57	1.2	OR	No	50.0	50.0	0.0	0.0	5.6	11.1	79.2	4.2
19*	2,729	182	3.9	TX	Yes	56.0	48.6	0.5	9.5	0.1	63.4	25.2	1.2

Source: CCD Public school data 2011-2012 school year.

*Schools with intervention programs (no treatment). †School data reflect total school enrollment, not high school enrollment alone.

Survey Completion

Survey completion was defined as responding to all items and clicking *submit* to finalize their results. In total, 6,068 students across the nineteen schools responded to at least one item on the survey. However, many students (23%) did not complete the survey and were excluded from the subsample used for analyses and so I conducted tests to determine whether or not the analytic subsample differed from the overall sample for student characteristics including school, grade point average, first language, race/ethnicity, mothers' education, grade level, and aspirations for after high school. As discussed below, there were statistically significant ($p < .01$) differences between those students who completed the survey and those who did not by school, grade point average, grade level, first language, race/ethnicity, FRPL eligibility, mothers' education, and aspirations for after high school.

Completion Rates by School

Results of chi-square analysis indicate that survey completion by school differed significantly ($\chi^2 = 39.52$, $df = 2$, $p < .01$). School completion rates ranged from 33% to 100% (Table 3.2).

Table 3.2

Student Completion Rates by School

School	*n*	*n* Complete	% Completed
1	61	20	100.0
2	321	295	98.3
3	149	113	96.0
4	233	183	94.5
5	491	438	94.2
6	791	388	91.9
7	417	393	89.2
8	857	532	88.0
9	212	204	87.5
10	78	63	80.8
11	465	369	79.4
12	54	34	78.5
13	705	617	75.8
14	250	166	66.4
15	434	410	63.0
16	75	66	62.1
17	119	119	61.1
18	58	57	49.1
19	298	182	32.8
Overall	6,068	4,649	76.6

Note. Bold font connotes low completion rate school.

Seventy percent of the students who did not complete the survey came from the six schools with the lowest completion rates (ranging from 33% to 66%); the survey completion rate across these six low completion schools was just 57% (Table 3.3). Students from the low completion rate schools submitted just 22% of the completed surveys.

Completion Rates by Student Characteristics

Eleven schools that participated in CampusReady in 2012-13 did not have grade point average scales that ranged from 0 to 4.0 and I excluded the students from those schools from the sample for the analyses addressing the sixth research question, which correlated students' scores with GPA.

Of the 3,054 of students whose GPAs were on a 0-4.0 scale, 2,483 completed CampusReady. The students who did not complete the survey reported slightly higher GPAs than students who did not complete the survey but those results were not significant ($F(1, 3{,}052) = 2.51$, *n.s.*, Table 3.3).

Table 3.3

Descriptive Statistics for GPA by Survey Completion

	Grade Point Average		
Completion	*n*	*M*	*SD*
Complete	2,483	2.74	0.97
Not Complete	571	2.81	1.01
Overall	3,054	2.75	0.97

There were significant differences in survey completion by student grade level, first language, race/ethnicity, FRPL eligibility, and mothers' education. The subsample of completed surveys used for analyses may overrepresent the following student subgroups:

- Twelfth grade students,
- Students whose first language is English,
- American Indian/Alaska Native students,
- White students,
- Students who do not know their FRPL eligibility, and
- Students whose mothers received a high school education or less.

Table 3.4 shows the results of the chi square analyses and CampusReady completion rates overall and by student subgroup.

Table 3.4

Survey Completion Rates Overall and by Student Subgroup and Results of Chi Square Analyses

Subgroup	*n*	% Complete	χ^2	*df*
Overall Students	6,068	76.7		
Grade Level	6,067		65.14*	3
Ninth	1,667	74.6		
Tenth	1,863	73.0		
Eleventh	1,349	76.8		
Twelfth	1,187	85.1		
Gender	6,066		1.25	1
Male	3,097	77.2		
Female	2,969	76.0		
First Language	6,060		39.52*	2
English	4,718	78.5		
Not English	1,286	70.7		
Don't Know	56	64.3		
Race/ethnicity	6,061		90.29*	6
Asian or Pacific Islander	350	69.7		
African American	873	74.5		
American Indian/Alaskan Native	52	88.5		
Hispanic/Latino	1,962	71.8		
White	2,129	83.0		
Multiple Categories/Mixed Race	527	76.3		
Prefer not to answer	168	77.4		
FRPL Status	6,067		5.82	2
Eligible	3,531	77.4		
Ineligible	2,194	75.0		
Don't Know	342	79.2		
Mother's Education	6,065		25.20*	7
Eighth grade or less	366	80.3		
Some high school	822	80.0		
High school grad.	1,374	78.6		
Some college	928	77.2		
Two-year college grad.	481	75.9		
Four-year college grad.	819	73.6		
Graduate degree	379	71.2		
Don't Know/NA	896	74.0		

Note. Subgroup *n* sizes reflect survey attrition. For example, 6,067 students reported grade level out of 6,068 students overall who responded to at least one survey item.
*$p < .01$

There were significant differences in survey completion by student responses to, "What are your plans for after high school?" The analytic subsample of completed surveys may overrepresent students who responded *other* to this question and students who responded that they planned to attend two-year college, travel, work, and join the military. Table 3.5 shows the results of the chi square analyses and CampusReady completion rates overall and by student aspirations.

Table 3.5

Survey Completion Rates Overall and by Student Aspirations and Results of Chi Square Analyses

Subgroup	*n*	% Complete	χ^2	*df*
Overall Students	6,068	76.7		
Aspirations	6,053		28.43*	9
Four-year college	3,367	75.9		
Two-year college	910	82.2		
Technical school	230	72.6		
Work	82	78.0		
Military	440	78.4		
Intern	319	77.4		
Travel	26	69.2		
Volunteer	15	66.7		
Other	160	81.3		
Not sure/don't know	504	72.4		

*$p < .01$

Participants

The subsample used for analyses consisted of the 4,649 students who responded to all items on the online survey and clicked *submit* to finalize their results. This section presents the characteristics of these students overall and by grade level including grade point average (GPA), background characteristics, and aspirations for after high school. The characteristics of the students in the analytic subsample are presented in Tables 3.8, 3.9, and 3.10.

Grade Level

The students who completed the survey were distributed fairly evenly across the grades with slightly more students in grades nine and ten (56%) than in grades eleven and twelve (44%, Table 3.6).

Table 3.6

Distribution of Students Across Grade Levels

Grade level	*n*	% of sample
Ninth	1,243	26.7
Tenth	1,360	29.3
Eleventh	1,036	22.3
Twelfth	1,010	21.7

Background Characteristics

Over all the grades, students were more than half male (51%). Most students (80%) reported that English was their first language and this trend was consistent over the grades. A small percentage of students (0.8%) reported that they did not know their first language. Students most frequently reported that they were White with 38% of students selecting that category, 30% of students reported that they were Hispanic/Latino, and 14% of students reported that they were African American.

Students were asked whether or not they were eligible for Free and Reduced Price Lunch (FRPL), 59% of the students reported that they were eligible, 35% reported that they were ineligible, and 6% of students reported that they did not know if they were eligible for FRPL with fewer twelfth grade students (3%) so reporting than ninth grade students (8%). Students were asked what level of education their mothers had completed, 59% of students reported that their mothers had no more than a high school education, 36% reported that their mothers had attended some college or had earned a college degree, and 6% reported that their mothers had attended graduate school. Over all the grades, 14% of students reported that they did not know, with fewer twelfth grade students (10%) reporting that they did not know their mothers' education than ninth grade students (19%). Table 3.7 displays student background characteristics overall and by grade.

Table 3.7

Student Background Characteristics

Subgroup	% Overall (*n* = 4,649)	% Ninth (*n* = 1,243)	% Tenth (*n* = 1,360)	% Eleventh (*n* = 1,036)	% Twelfth (*n* = 1,010)
Gender					
Male	51.5	52.4	51.0	53.8	48.5
Female	48.5	47.6	49.0	46.2	51.5
First Language					
English	79.7	78.5	80.4	80.9	78.8
Not English	19.6	20.4	18.8	18.5	20.6
Don't Know	0.8	1.1	0.7	0.6	0.6
Race/ethnicity					
Asian or Pacific Islander	5.2	4.7	3.7	6.0	7.3
African American	14.0	14.3	13.1	15.0	13.8
American Indian/ Alaskan Native	1.0	1.2	0.7	1.0	1.2
Hispanic/Latino	30.3	32.6	31.0	28.2	28.8
White	38.0	32.2	41.8	39.4	38.7
Multiple Categories/ Mixed Race	8.6	11.7	7.4	8.0	7.2
Prefer not to answer	2.8	3.4	2.4	2.5	3.0
FRPL Status					
Eligible	58.8	57.0	59.3	63.9	55.0
Ineligible	35.4	34.9	34.0	31.7	41.7
Don't Know	5.8	8.1	6.7	4.4	3.3
Mother's Education					
Eighth grade or less	6.3	5.0	6.0	6.9	7.7
Some high school	14.2	13.2	14.2	15.7	13.7
High school grad.	23.2	19.7	22.4	24.8	27.0
Some college	15.4	14.3	15.2	15.7	16.6
Two-year college grad.	7.9	6.5	8.5	7.9	8.6
Four-year college grad.	13.0	14.8	13.5	10.8	12.2
Graduate degree	5.8	7.8	5.6	5.3	4.2
Don't Know/NA	14.3	18.7	14.6	12.7	10.0

Aspirations

This study explores students' responses to the item, "What are your plans for the fall after you graduate from high school?" More than half (55%) of students reported that they planned to attend a four-year college or university after high school, with fewer twelfth graders so reporting than students in other grades. The reverse is true of students

who reported that they planned to attend a two-year college: overall 16% so reported with far more twelfth grade students (29%) reporting two-year college plans than ninth grade students (9%). Over all students in the subsample, 8% reported that they did not know their plans for after high school with more ninth grade students (10%) so reporting than twelfth (4%). Students' responses to this item overall and by grade are presented in Table 3.8.

Table 3.8

Student Aspirations Overall and by Grade

Aspiration	% Overall (*n* = 4,649)	% Ninth (*n* = 1,243)	% Tenth (*n* = 1,360)	% Eleventh (*n* = 1,036)	% Twelfth (*n* = 1,010)
Four-year college	55.0	59.2	60.1	50.1	47.7
Two-year college	16.1	9.1	11.5	18.1	28.7
Technical school	3.6	3.5	2.4	4.3	4.6
Work	1.4	1.9	1.0	2.0	0.7
Military	7.4	6.7	7.5	9.0	6.6
Intern	5.3	5.0	6.2	4.4	5.4
Travel	0.4	0.5	0.3	0.4	0.4
Volunteer	0.2	0.4	0.1	0.2	0.2
Other	2.8	4.3	2.1	3.1	1.6
Not sure/ don't know	7.9	9.5	8.8	8.3	4.1

Grade Point Average

Again, eleven schools in the sample did not use a 0-4.0 grading scale and those data were excluded from the analysis addressing research question six. Among the 2,483 students who completed CampusReady and whose grading systems were on a 0-4.0 scale, average student GPA was 2.74 (*SD* = 0.97); students in grade nine reported lower GPAs than students in the other grades (Table 3.9).

Table 3.9

Student Grade Point Average Overall and by Grade for Survey Completers from Schools on 0-4.0 Grading Scale

		Grade Point Average	
Grade Level	*n*	*M*	*SD*
Overall	2,483	2.74	0.97
Ninth	651	2.66	1.09
Tenth	624	2.76	1.00
Eleventh	584	2.76	0.91
Twelfth	624	2.77	0.84

Note. The distribution of GPA is symmetrical with no severe outliers.

Computed and Recoded Variables

The source of data for this study was high school students' responses on the 2012-13 administration of the CampusReady survey. Items are grouped by Key, aspect, and component and are presented with prompts that define the component measured by the items on the page. Student items in each Key elicit student's responses to how well each item describes them on a five-point Likert-type scale ranging from *not at all like me* to *very much like me* with the option to select *don't know/not applicable* in response to any item. Scores for each Key are averages of students' responses to items on this scale across items within Keys, and then across users. Because the inclusion of *Don't know/not applicable* responses in calculating scores has ramifications for at-risk populations, these responses were coded as 0 on the scale and included in the calculations of students' CampusReady scores (see Lombardi, Seburn, & Conley (2011b) for a thorough discussion of the coding of *Don't know/not applicable* responses).

Research questions two through four examine the differences in CampusReady scores by student background characteristics including student's first language,

race/ethnicity, and mother's education. Less than 1% of students over all grades reported that they did not know their first language with just 0.6% of eleventh and twelfth grade students so reporting (Table 3.10). Because this student subgroup was so small, I recoded the first language variable so that these students were included with the students who reported that English was not their first language. I made the decision to recode these students, rather than exclude them, under the assumption that these students reported that they did not know their first language because they were raised in bilingual households and so may face similar challenges when preparing for college and careers as students whose first language is not English.

Some student racial/ethnic subgroups were also small, 5% of students overall the grades reported that they were Asian American or Pacific Islander students with just 4% of tenth grade students so reporting (Table 3.10). I recoded the race/ethnicity variable to combine Asian American students and White students because these students tend to have similar, higher, college graduation rates than other racial/ethnic groups (Aud, et al., 2010). Similarly, only 1% of students reported that they were American Indian/Alaska Native with just 0.7% of students in grade ten so reporting (Table 3.10). I recoded the race/ethnicity variable to combine American Indian/Alaska Native students with African American students because students from racial/ethnic groups tend to have similar, lower, college graduation rates than students from other groups (Aud, et al., 2010). I also combined the students who reported that they are *multiple categories/mixed race* and who responded that they preferred not to answer.

Some subgroups based on mothers' education were too small for analyses and required recoding to combine with other students. Groups were recoded as follows:

- Students whose mothers had not graduated from high school
- Students whose mothers had graduated from high school
- Students whose mothers had attended college
- Students whose mothers had earned a graduate degree
- Students who did not know their mother's education.

Table 3.10 presents the variables of interest before and after recoding

Table 3.10

Recoded Student Subgroup Variables

Original Variable	% Overall	Recoded Variable	% Overall	% Ninth	% Tenth	% Eleventh	% Twelfth
First Language		First Language					
English	79.7	English	79.7	78.5	80.4	80.9	78.8
Not English	19.6	Not English & Don't Know	20.3	21.5	19.6	19.1	21.2
Don't Know	0.8						
Race/ethnicity		Race/ethnicity					
Asian or Pacific Islander	5.2	Asian or Pacific Islander & White	43.3	36.8	45.5	45.4	46.0
White	38.0						
African American	14.0	African American & American Indian/Alaskan Native	15.0	15.5	13.8	15.9	15.0
American Indian/ Alaskan Native	1.0						
Hispanic/Latino	30.3	Hispanic/Latino	30.3	32.6	31.0	28.2	28.8
Multiple Categories/ Mixed Race	8.6	Multiple Categories/Mixed Race & Prefer not to answer	11.4	15.0	9.8	10.5	10.2
Prefer not to answer	2.8						
Mother's Education		Mother's Education					
Eighth grade or less	6.3	Not high school grad.	20.5	18.2	20.2	22.7	21.4
Some high school	14.2						
High school grad.	23.2	High school grad.	23.2	19.7	22.4	24.8	27.0
Some college	15.4	Attended College	36.2	35.6	37.2	34.5	37.4
Two-year college grad.	7.9						
Four-year college grad.	13.0						
Graduate degree	5.8	Graduate degree	5.8	7.8	5.6	5.3	4.2
Don't Know/NA	14.3	Don't Know/NA	14.3	18.7	14.6	12.7	10.0

Research question five examines student aspirations overall and by grade. Like student background characteristics, some subgroups of students based on their aspirations were too small to conduct analyses and were recoded. Students who aspired to attend two- or four-year college were recoded as *College*. Students who aspired to attend technical school, work, join the military, or intern were recoded as *Career.* Students who aspired to travel, volunteer, or who responded *other* were recoded as *Other*. I left intact the group of students who responded that they did not know their plans. Table 3.11 shows the recoded aspirations variables.

Table 3.11

Student Aspirations Overall and by Grade

Original		Recoded					
Aspiration	% Overall	Aspiration	% Overall	% Ninth	% Tenth	% Eleventh	% Twelfth
Four-year college	55.0	College	71.0	68.3	71.7	68.2	76.4
Two-year college	16.1						
Technical school	3.6	Career	16.7	15.6	16.4	18.1	17.0
Work	7.4						
Military	5.3						
Intern	0.4						
Travel	1.4	Other	4.4	6.6	3.1	5.3	2.5
Volunteer	0.2						
Other	2.8						
Not sure/ don’t know	7.9	Not sure/ don’t know	7.9	9.5	8.8	8.3	4.1

Analyses and Statistical Methods

This section presents the analyses and statistical methods used to address the research questions along with my hypothesis for each question. For all analyses, I used a rejection rule of $p < .01$ because of the large sample size and to control for family-wise error.

Grade Level

The first research question was, "Do CampusReady scores differ significantly by grade level?" I addressed this research question using one-way, between subjects analysis of variance (ANOVA), which is an appropriate technique to use when exploring differences in population means when differences among groups are anticipated. ANOVA results are reported as an *F* ratio, which is an estimate of the difference in sample means where the numerator (MS_A) is an estimate of the differences between the two groups, and the denominator ($MS_{S/A}$) represents error variance (Keppel & Zedeck, 2006). ANOVA is a hypothesis-driven analysis that starts from the assumption that the means of the different populations will be equal.

Using Cohen's (1992) criteria for effect sizes (Table 3.12) I hypothesized that students' grade level would have a small effect on CampusReady scores and that older students would have higher scores in each Key than younger students with the largest differences between ninth and twelfth grades. Where there were statistically significant effects of grade level on CampusReady scores, I controlled for grade level in the analyses used to address research questions two through five using grade level as a covariate in the ANOVA.

Table 3.12

Strength of Effects

Effect Size	Cohen's *d*	Pearson's *r*
Small	.20	.10
Medium	.50	.30
Large	.80	.50

Note. Adapted from Cohen (1992)

Background Characteristics

Research questions two through five explored the differences in CampusReady scores based on students' background characteristics including race/ethnicity, mother's education, and first language. In order to address these questions, I conducted two-way analyses of variance to determine if there were significant differences in students' mean CampusReady scores based on students' race/ethnicity, first language, and mothers' education for each Key when controlling by grade. For each of these analyses, I hypothesized that there would be no significant differences in CampusReady scores based on student background characteristics and controlling by grade, which would provide some evidence that the survey is not biased against students based on the background characteristics examined.

Aspirations

The fifth research question was, "Do CampusReady scores differ significantly based on students' aspirations for after high school and does that effect depend on grade level where grade level had a significant effect on CampusReady scores?" To address this research question, I conducted an analysis of the variance (two-way ANOVA) in

students' CampusReady scores for each Key to determine if there are differences in students' mean CampusReady scores based on their aspirations for after high school for students who aspired to attend college, those who planned to work, and those reporting that they did not know their plans or *other* when controlling by grade. I conducted this analysis to explore the concurrent criterion-related validity evidence for CampusReady score interpretation and I hypothesized that students' aspirations would have a medium sized effect on CampusReady scores (Table 3.12) in that students aspiring to attend college would have higher scores than students who aspired to work or who had unknown plans

Grade Point Average

The sixth research question was, "What are the relationships between students' CampusReady scores and their high school GPA? How do these relationships differ by grade level?" To address this question, I correlated students' scores in each Key (Key Cognitive Strategies, Key Content Knowledge, Key Learning Skills and Techniques, Key Transition Knowledge and Skills) with self-reported high school GPA using the Pearson correlation coefficient (Pearson's *r),* which is a measure of the dependence between two variables. Correlations are commonly used in validity studies because they allow researchers to explore the dependence of two measures such as test scores and GPA (AERA, APA, & NCME, 1999; Camara & Echternacht, 2000, Cronbach & Meehl, 1955). In addition to looking at these relationships for all high school students, I conducted this analysis for each grade to determine whether or not the relationship between students' scores and their GPA grew stronger as they approached graduation. Using Cohen's (1992) criteria for effect sizes (Table 3.12) I hypothesized that the relationships between

student scores and GPA would be small with larger effects in higher grades than in lower grades.

CHAPTER IV

RESULTS

This chapter presents the results from quantitative analyses designed to address the research questions. The first section presents the results of the analysis addressing research question one, which explored the differences in CampusReady scores by grade level. The second section presents the results of the analyses addressing research questions two through four, which explored the differences in CampusReady scores by student background characteristics including race/ethnicity, mother's education, and first language. The third section presents the results of the analyses addressing the fifth research question, which explored the differences in CampusReady scores by students' aspirations for after high school. The fourth section presents the results of the analyses addressing the sixth research question, which explored the relationships between students' CampusReady scores and their self-reported GPA for students from schools using a 0-4.0 grading scale.

Student CampusReady scores and self-reported GPA met the assumptions underlying these analyses including the assumptions of normality, homoscedasticity, and linearity. The distribution of CampusReady scores in each Key overall and by grade is approximately normal with no severe outliers that would affect the mean. Student GPA is also normally distributed, however 106 students reported GPAs of 0. I included these cases in the analytic subsample as no clear pattern emerged to indicate why these students responded that their GPA was so low: these students were distributed fairly evenly across the grades, among the student characteristics used to address research questions two through four, by student aspirations, and over participating schools.

Grade Level

The first research question was, "Do students' CampusReady scores differ significantly based on grade level?" Data were analyzed with a one-way, between-subjects analysis of variance with the results presented in table 4.1. The independent variable was students' grade with four levels: ninth, tenth, eleventh, and twelfth. The dependent variables were students' Key Cognitive Strategies (KCS), Key Content Knowledge (KCK), Key Learning Skills and Techniques (KLST), and Key Transition Knowledge and Skills (KTKS) scores. There were significant differences by grade level for KCS scores and KTKS scores but grade level had no effect on KCK or KLST scores (Table 4.1).

Table 4.1

Descriptive Statistics for CampusReady scores by Grade Level and Overall

	Ninth (n = 1,243)		Tenth (n = 1,360)		Eleventh (n = 1,036)		Twelfth (n = 1,010)		Overall (n = 4,649)	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
KCS	3.27^{a}	0.83	3.36^{ab}	0.78	3.42^{b}	0.79	3.56^{c}	0.78	3.39	0.80
KCK	3.40^{d}	0.84	3.43^{d}	0.79	3.47^{d}	0.80	3.51^{d}	0.82	3.45	0.81
KLST	3.33^{e}	0.87	3.40^{e}	0.79	3.47^{e}	0.85	3.40^{e}	0.83	3.40	0.83
KTKS	2.97^{f}	0.95	3.12^{g}	0.92	3.30^{h}	0.97	3.62^{i}	0.98	3.23	0.98

Note. Group means sharing a common superscript within a row are not significantly different (p < .01).

As shown in Table 4.1, there were significant differences by grade level for KCS scores ($F(3, 4645) = 27.01$, $p < .01$). I conducted post-hoc comparisons using the Tukey HSD test. Twelfth grade students scored higher on KCS than other students but these differences were small: twelfth grade students scored approximately 1/3 of a standard deviation higher than ninth grade students (d = .37) and 1/4 of a standard deviation higher than tenth grade students (d = .25). There were statistically significant differences between ninth and eleventh (d = .19) and eleventh and twelfth grade students' scores (d =

.18) but these differences would not even rate as small according to Cohen (1992). There were no statistically significant differences in KCS scores between ninth and tenth and tenth and eleventh grade students.

In contrast to the KCS results, there were no significant differences by grade level in KCK scores ($F(3, 4645) = 3.64$, $p = .012$) or KLST scores ($F(3, 4645) = 5.09$, $p = .02$). However, as with KCS there were significant differences by grade level for KTKS scores ($F(3, 4645) = 93.93$, $p < .01$). All of the grade level differences for the KTKS were significant, there was a medium-sized difference between ninth and twelfth grade students' scores with twelfth grade students scoring 2/3 of a standard deviation higher than ninth grade students ($d = .66$). There was also a medium-sized difference between tenth and twelfth grade students' scores with twelfth grade students scoring 1/2 of a standard deviation higher than tenth grade students ($d = .50$). There was a small difference between ninth and eleventh grade students' scores with eleventh grade students scoring 1/3 of a standard deviation higher than ninth grade students ($d = .33$). There were statistically significant differences between ninth and tenth ($d = .16$) and tenth and eleventh ($d = .17$) grade students' scores but these differences would not rate as small according to Cohen (1992).

Background Characteristics

Race/Ethnicity

The second research question was, "Do CampusReady scores differ significantly based on students' race/ethnicity and does that effect depend on grade level where grade level had a significant effect on CampusReady scores?" As discussed, this research question sought to examine the evidence of the consequential validity of CampusReady by analyzing the effect of student background characteristics on CampusReady scores.

This research question was addressed through between-subjects analyses of variance (ANOVA) with the results discussed in the following subsections. For the Keys where grade level did have a statistically significant effect on students' scores (KCS and KTKS), I analyzed the data with two-way, between subjects analyses of variance (ANOVA). The independent variables were student grade level and race/ethnicity. Grade had four levels: ninth, tenth, eleventh, and twelfth. Race/ethnicity had four levels: Asian American and White students, African American and American Indian/Alaska Native students, Hispanic students, and students responding that they were multiple/mixed race or that they preferred not to answer. The dependent variables were KCS and KTKS scores. For the Keys where grade level did not have a significant effect (KCK and KLST), I analyzed the data with one-way, between subjects ANOVA. The independent variable was student race/ethnicity and the dependent variables were students' KCK and KLST scores.

Results from these analyses indicate that students' race/ethnicity did have statistically significant effects on students' CampusReady scores for this sample of

students. However, there was no grade-by-race interaction effect on students' KCS or KTKS scores. The following sections and Table 4.2 present the results of these analyses.

Table 4.2

Descriptive Statistics for CampusReady scores by Race/Ethnicity

	White & Asian/PI (n = 2,012)		Black & Am Ind/AK Nat. (n = 696)		Hispanic/ Latino (n = 1,409)		Multiple Race & NA (n = 532)	
Key	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
KCS	3.43[a]	0.82	3.44[a]	0.80	3.31[b]	0.77	3.41[ab]	0.81
KCK	3.46[cd]	0.80	3.55[c]	0.82	3.40[d]	0.81	3.42[cd]	0.87
KLST	3.39[e]	0.85	3.52[f]	0.82	3.35[e]	0.79	3.39[ef]	0.86
KTKS	3.22[g]	0.97	3.39[h]	0.97	3.18[g]	0.97	3.19[g]	1.06

Note. Group means sharing a common superscript within a row are not significantly different (p < .01).

Key Cognitive Strategies. The grade level-by-race/ethnicity interaction effect on KCS scores was not significant, but there were significant main effects of grade and race/ethnicity (Table 4.3). I conducted post-hoc comparisons using the Tukey HSD test. Over all the grade levels, African American and American Indian/Alaska Native students and White and Asian American students scored significantly higher than Hispanic/Latino students on Key Cognitive Strategies. These effects did not even rate as small according to Cohen, nevertheless they were significant. African American and American Indian/Alaska Native students scored approximately 1/6 of a standard deviation higher than Hispanic/Latino students on the KCS (d = 0.16) and White/Asian American students scored 1/7 of a standard deviation higher than Hispanic/Latino students (d = .14). Tables 4.2 and 4.3 present the results of these analyses.

Table 4.3

Grade Level by Race/ethnicity Analysis of Variance Summary Table for KCS

Source	*df*	Sum of Squares	Mean Square	*F*
Grade level	3	33.75	11.25	17.86*
Race/ethnicity	3	10.93	3.65	5.79*
Grade level by race/ethnicity	9	5.9	0.66	1.04
Error	4633	2918.84	0.63	
Total	4648	2987.28		

*$p < .01$

Key Transition Knowledge and Skills. Like the KCS, the grade level-by-race/ethnicity interaction effect on Key Transition Knowledge and Skills (KTKS) scores was not significant, but there were significant main effects of grade and race/ethnicity (Table 4.4). Although these effects were statistically significant, they would not even rate as small according to Cohen's (1992) guidelines. Over all the grade levels, African American and American Indian/Alaska Native students scored approximately 1/5 of a standard deviation higher than the other students on KTKS (Table 4.2). The greatest differences were between African American and American Indian/Alaska Native students and Hispanic/Latino students (d = .22) and between African American and American Indian/Alaska Native students and multiple/mixed race students and students who preferred not to answer (d = .22), with an even smaller difference between African American and American Indian/Alaska Native and White and Asian/Pacific Islander students' scores (d = .19). Tables 4.2 and 4.4 present the results of these analyses.

Table 4.4

Grade Level by Race/Ethnicity Analysis of Variance Summary Table for KTKS

Source	*df*	Sum of Squares	Mean Square	*F*
Grade level	3	178.10	59.37	65.42*
Race/ethnicity	3	20.24	6.75	7.43*
Grade level by race/ethnicity	9	8.42	0.94	1.032
Error	4633	4204.36	0.91	
Total	4648	4491.02		

*$p < .01$

Key Content Knowledge. There were no significant differences by grade for Key Content Knowledge (KCK) and so I analyzed the differences in student scores in this Key using a one-way, between-subjects analysis of variance with students' race/ethnicity as the independent variable and the dependent variable was KCK scores. The effect of race/ethnicity on students' Key Content Knowledge (KCK) scores was statistically significant but the differences in students' scores by race/ethnicity would not even rate as small according to Cohen's guidelines (1992): African American and American Indian/Alaska Native students scored approximately 1/5 of a standard deviation higher than Hispanic/Latino students on the KCK ($d = .19$) and there were no statistically significant differences in KCK scores among other groups of students. Tables 4.2 and 4.5 present the results of these analyses.

Table 4.5

Grade Level by Race/ethnicity Analysis of Variance Summary Table for KCK

Source	*df*	Sum of Squares	Mean Square	*F*
Race/ethnicity	3	12.09	4.03	6.10*
Error	4645	3065.61	0.66	
Total	4648	3077.79		

*$p < .01$

Key Learning Skills and Techniques. As with the KCK, there were no significant differences by grade for Key Learning Skills and Techniques (KLST) and so I analyzed the differences in student scores in this Key using a one-way, between-subjects analysis of variance with students' race/ethnicity as the independent variable and the dependent variable was KLST scores. The effect of race/ethnicity on students' KLST scores was significant (Table 4.6). However, the differences in scores by race/ethnicity would not rate as small according to Cohen's guidelines (1992). African American and American Indian/Alaska Native students scored approximately 1/5 of a standard deviation higher than Hispanic/Latino students (d = .20) and approximately 1/7 of a standard deviation higher than White and Asian students (*d* = .15). Tables 4.2 and 4.6 present the results of these analyses.

Table 4.6

Grade Level by Race/ethnicity Analysis of Variance Summary Table for KLST

Source	*df*	Sum of Squares	Mean Square	*F*
Race/ethnicity	3	13.22	4.41	6.41*
Error	4645	3195.02	0.69	
Total	4648	3208.24		

*$p < .01$

Mothers' Education

The third research question was, "Do CampusReady scores differ significantly based on students' mother's education and does that effect depend on grade level where grade level had a significant effect on CampusReady scores?" This research question was addressed through between-subjects analyses of variance (ANOVA) with the results discussed in the following subsections. For the Keys where grade level did have a statistically significant effect on students' scores (KCS and KTKS), I analyzed the data

with two-way, between subjects analyses of variance (ANOVA). The independent variables were student grade level and mothers' education. Mother's education had five levels: not high school graduate, high school graduate, attended college, earned graduate degree, and students who did not know their mother's education. The dependent variables were KCS and KTKS scores. For the Keys where grade level did not have a significant effect (KCK and KLST), I analyzed the data with one-way, between subjects ANOVA. The independent variable was mothers' education and the dependent variables were students' KCK and KLST scores.

Results from these analyses indicate that mothers' education did have statistically significant effects on students' CampusReady scores for this sample of students. However, there was no grade-by-mothers' education interaction effect on students' KCS or KTKS scores. The following sections and Table 4.7 present the results of these analyses.

Table 4.7

Descriptive Statistics for CampusReady scores by Mothers' Education

	No HSD (n = 952)		HSD (n = 1,080)		College (n = 1,684)		Grad Sch. (n = 270)		Don't Know/ NA (n = 663)	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
KCS	3.28[a]	0.81	3.38[a]	0.74	3.52[b]	0.75	3.72[c]	0.84	3.12[d]	0.88
KCK	3.33[e]	0.83	3.45[f]	0.77	3.55[g]	0.77	3.66[g]	0.85	3.27[e]	0.89
KLST	3.31[hk]	0.83	3.38[h]	0.78	3.51[i]	0.79	3.71[j]	0.89	3.17[k]	0.91
KTKS	3.09[l]	1.00	3.24[m]	0.93	3.41[n]	0.92	3.55[n]	1.05	2.83[o]	1.02

Note. Group means sharing a common superscript within a row are not significantly different (p < .01).

Key Cognitive Strategies. The grade level-by-mothers' education interaction effect on KCS scores was not significant, but there were significant main effects of grade and mothers' education (Table 4.8). I conducted post-hoc comparisons using the Tukey HSD test. Over all the grade levels, students whose mothers attended graduate school or college scored significantly higher on KCS than students in other groups (Table 4.7). Using Cohen's (1992) criteria for effect sizes, there was a medium sized difference in scores between students whose mothers attended graduate school and students who did not know their mothers' education (d = .75), between students whose mothers had attended graduate school and students whose mothers had not graduated from high school (d = .54), and between students whose mothers attended college and students who did not know their mothers' education (d = .50).

There was a small difference in KCS scores between students whose mothers had not graduated from high school and students who did not know their mothers' education (d = .21). Although statistically significant, the difference in scores between students whose mothers had not graduated from high school and students whose mothers were high school graduates would not even rate as small according to Cohen's (1992) guidelines (d = .12). Tables 4.7 and 4.8 present the results of these analyses.

Table 4.8

Grade Level by Mothers' Education Analysis of Variance Summary Table for KCS

Source	*df*	Sum of Squares	Mean Square	*F*
Grade level	3	31.76	31.76	17.43*
Mothers' education	4	101.65	101.65	41.83*
Grade level by mothers' education	12	10.12	10.12	1.39
Error	4629	2811.84	2811.84	
Total	4648	2987.28	2987.28	

*p < .01

Key Transition Knowledge and Skills. Like the KCS, grade level-by-mothers' education interaction effect was not significant, but there were significant main effects of grade and mothers' education on KTKS scores (Table 4.11). I conducted post-hoc comparisons using the Tukey HSD test. As with the KCS, over all the grade levels, students whose mothers attended graduate school or college scored significantly higher on KTKS than students in other groups (Table 4.7). Students whose mothers had attended graduate school scored approximately 3/4 of a standard deviation higher than students who did not know their mothers' education (d = .74), and there was also a medium-sized KTKS score difference between students whose mothers had attended college and students who did not know their mothers' education (d = .59).

There were small differences in KTKS scores between students whose mothers had not graduated from high school and students whose mothers had attended graduate school (*d* = .47), and between students who did not know their mothers' education and students whose mothers had graduated from high school (*d* = .41). Although statistically significant, the difference in KTKS scores between students whose mothers had graduated from high school and students whose mothers had attended college would not rate as small according to Cohen's (1992) guidelines (*d* = .17). There were no significant differences in KTKS scores between students whose mothers had attended college and students whose mothers had attended graduate school. Tables 4.7 and 4.9 present the results of these analyses.

Table 4.9

Grade Level by Mothers' Education Analysis of Variance Summary Table for KTKS

Source	*df*	Sum of Squares	Mean Square	*F*
Grade level	3	143.29	47.76	54.86*
Mothers' education	4	185.19	46.30	53.18*
Grade level by mothers' education	12	11.38	0.95	1.09
Error	4629	4030.00	0.87	
Total	4648	4491.02		

*$p < .01$

Key Content Knowledge. There were no significant differences by grade for Key Content Knowledge (KCK) and so I analyzed the differences in student scores in this Key using a one-way, between-subjects analysis of variance with mothers' education as the independent variable and the dependent variable was KCK scores. The effect of mothers' education on KCK scores was significant (Table 4.10). I conducted post-hoc comparisons using the Tukey HSD test, students whose mothers attended graduate school or college scored significantly higher than the other groups (Table 4.7).

Over all the grades, students whose mothers had attended graduate school or college scored higher than other students. There were no significant differences in KCK scores between students whose mothers had attended college and students whose mothers had attended graduate school. There were small differences in KCK scores between students whose mothers had attended graduate school and students who did not know their mothers' education and students whose mothers had not graduated from high school: students whose mothers had attended graduate school scored almost 1/2 of a standard deviation higher than students who did not know their mothers' education (d = .48) and approximately 2/5 of a standard deviation higher than students whose mothers had not graduated from high school (d = .42). There were also small differences in KCK

scores between students whose mothers had attended college and students who did not know their mothers' education (d = .28), as well as between students whose mothers had attended graduate school and students whose mothers had graduated from high school (d = .27). Tables 4.7 and 4.10 present the results of these analyses.

Table 4.10

Grade Level by Mothers' Education Analysis of Variance Summary Table for KCK

Source	*df*	Sum of Squares	Mean Square	*F*
Mothers' education	4	67.07	26.77	25.86*
Error	4644	3010.63	0.65	
Total	4648	3077.69		

*p < .01

Key Learning Skills and Techniques. As with the KCK, there were no significant differences by grade for Key Learning Skills and Techniques (KLST) and so I analyzed the differences in student scores in this Key using a one-way, between-subjects analysis of variance with mothers' education as the independent variable and the dependent variable was KLST scores. The effect of mothers' education on students' KLST scores was significant (Table 4.11). I conducted post-hoc comparisons using the Tukey HSD test (Table 4.7). As in the other Keys, students whose mothers attended graduate school or college scored significantly higher than the other groups.

Over all the grades, there were medium-sized differences in KLST scores between students whose mothers had attended graduate school and students who did not know their mothers' education (d = .65), and between students whose mothers had attended graduate school and students whose mothers did not graduate from high school (d = .49). There was a small difference in KLST scores between students whose mothers had attended college and students whose mothers had attended graduate school (d = .25).

There were no significant differences in KLST scores between students whose mothers had not graduated from high school and students whose mothers had graduated from high school, or between students whose mothers had not graduated from high school and students who did not know their mothers' education. Tables 4.7 and 4.11 present the results of these analyses.

Table 4.11

Grade Level by Mothers' Education Analysis of Variance Summary Table for KLST

Source	*df*	Sum of Squares	Mean Square	*F*
Mothers' education	4	87.92	21.98	32.71*
Error	4644	3120.32	0.67	
Total	4648	3208.24		

*$p < .01$

First Language

The fourth research question was, "Do CampusReady scores differ significantly based on students' first language and does that effect depend on grade level where grade level had a significant effect on CampusReady scores?" This research question was addressed through between-subjects analyses of variance (ANOVA) with the results discussed in the following subsections. For the Keys where grade level did have a statistically significant effect on students' scores (KCS and KTKS), I analyzed the data with two-way, between subjects analyses of variance (ANOVA). The independent variables were student grade level and first language. First language had two levels: English and not English or *Don't Know*. The dependent variables were KCS and KTKS scores. For the Keys where grade level did not have a significant effect (KCK and KLST), I analyzed the data with one-way, between subjects ANOVA. The independent

variable was student first language and the dependent variables were students' KCK and KLST scores.

Results from these analyses indicate that first language did not have statistically significant effects on students' CampusReady scores for this sample of students and there was no grade-by-first language interaction effect on students' KCS or KTKS scores. The following sections and Table 4.12 present the results of these analyses.

Table 4.12

Descriptive Statistics for CampusReady Scores by First Language

	English (n = 3,704)		Not English/ Don't Know (n = 945)	
Key	*M*	*SD*	*M*	*SD*
KCS	3.41[a]	0.80	3.32[a]	0.80
KCK	3.46[b]	0.82	3.40[b]	0.81
KLST	3.41[c]	0.84	3.37[c]	0.81
KTKS	3.25[d]	0.99	3.16[d]	0.95

Note. Group means sharing a common superscript within a row are not significantly different (p < .01).

Key Cognitive Strategies. As discussed in the grade level section above, there was a significant effect of grade level on KCS scores, however the grade level-by-first language interaction effect was not significant, nor was there a significant main effect of first language on KCS scores. Tables 4.12 and 4.13 present the results of these analyses.

Table 4.13

Grade Level by First Language Analysis of Variance Summary Table for KCS

Source	*df*	Sum of Squares	Mean Square	*F*
Grade level	3	48.22	16.07	25.50*
First language	1	5.76	5.76	9.14
Grade level by first language	3	4.79	1.60	2.53
Error	4641	2924.52	0.63	
Total	4648	2987.28		

*$p < .01$

Key Transition Knowledge and Skills. As discussed above, there was a significant effect of grade level on KCS scores, however the grade level-by-first language interaction effect was not significant, nor was there a significant main effect of first language on KTKS scores. Tables 4.12 and 4.14 present the results of these analyses.

Table 4.14

Grade Level by First Language Analysis of Variance Summary Table for KTKS

Source	*df*	Sum of Squares	Mean Square	*F*
Grade level	3	199.71	66.57	73.14*
First language	1	4.43	4.43	4.87
Grade level by first language	3	4.60	1.54	1.69
Error	4641	4224.33	0.91	
Total	4648	44.91.02		

*$p < .01$

Key Content Knowledge. The effect of first language on students' Key Content Knowledge (KCK) scores was not significant. Tables 4.12 and 4.15 present the results of these analyses.

Table 4.15

Grade Level by First Language Analysis of Variance Summary Table for KCK

Source	*df*	Sum of Squares	Mean Square	*F*
First language	1	2.58	2.68	3.90
Error	4647	3075.11	0.66	
Total	4648	3077.69		

*$p < .01$

Key Learning Skills and Techniques. The effect of first language on students' KLST scores was not significant. Tables 4.12 and 4.16 present the results of these analyses.

Table 4.16

Grade Level by First Language Analysis of Variance Summary Table for KLST

Source	*df*	Sum of Squares	Mean Square	*F*
First language	1	0.82	0.82	1.19
Error	4647	3207.42	0.69	
Total	4648	3208.24		

*$p < .01$

Aspirations

The fifth research question was, "Do CampusReady scores differ significantly based on students' post-high school aspirations and does that effect depend on grade level where grade level had a significant effect on CampusReady scores?" As discussed, I hypothesized that no subgroup differences would exist and the results of this analysis provide preliminary consequential validity evidence for CampusReady score interpretation.

For the Keys where grade level did have a statistically significant effect on students' scores (KCS and KTKS), I analyzed the data with two-way, between subjects analyses of variance (ANOVA). The independent variables were student grade level and aspirations. Aspirations had four levels: College, Career, Other, and Don't Know. The

dependent variables were KCS and KTKS scores. For the Keys where grade level did not have a significant effect (KCK and KLST), I analyzed the data with one-way, between subjects ANOVA. The independent variable was students' aspirations and the dependent variables were KCK and KLST scores.

Results from these analyses indicate that aspirations did not have statistically significant effects on students' CampusReady scores for this sample of students. There was no grade-by-aspirations interaction effect on KCS scores but there was a significant interaction effect on KTKS scores. The following sections and Table 4.17 present the results of these analyses.

Table 4.17

Descriptive Statistics for CampusReady Scores by Aspirations

	College (n = 3,303)		Career (n = 777)		Other (n = 204)		Don't Know (n = 365)	
Key	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
KCS	3.52[a]	0.74	3.13[b]	0.84	3.10[b]	0.98	3.00[b]	0.83
KCK	3.58[c]	0.72	3.18[d]	0.92	3.08[d]	1.01	3.05[d]	0.91
KLST	3.55[e]	0.75	3.09[f]	0.86	2.99[f]	1.01	2.93[f]	0.89

Notes. Group means sharing a common superscript within a row are not significantly different (p < .01). Because there was a significant grade-by-aspirations effect on KTKS scores, those results are presented separately.

Key Cognitive Strategies. The grade level-by-aspirations interaction effect on KCS scores was not significant, but there were significant main effects of grade and aspirations (Table 4.18). I conducted post-hoc comparisons using the Tukey HSD test. Over all the grade levels, there were medium-sized differences in KCS scores based on aspirations. Students who aspired to attend college scored significantly higher on KCS than students who planned to work (d = .65), who had other plans (d = .52), and who responded that they did not know their plans for after high school (d = .49). Tables 4.17 and 4.18 present the results of these analyses.

Table 4.18

Grade Level by Aspirations Analysis of Variance Summary Table for KCS

Source	*df*	Sum of Squares	Mean Square	*F*
Grade level	3	8.41	2.80	4.71*
Aspirations	3	164.61	54.87	92.19*
Grade level by aspirations	9	9.09	1.01	1.70
Error	4633	2757.51	0.56	
Total	4848	2987.28		

*$p < .01$

Key Transition Knowledge and Skills. Unlike the other Keys and independent variables, the grade-by-aspirations interaction effect was significant for Key Transition Knowledge and Skills (KTKS) (Table 4.19). Among students who aspired to attend college, there were significant differences in KTKS scores between all the grade levels ($p < .01$). There was a medium sized difference in KTKS scores between ninth and twelfth grade students, with twelfth grade students with college plans scoring almost 3/4 of a standard deviation higher than ninth grade students with college plans ($d = .72$). There was also a medium sized difference in KTKS scores between ninth and tenth grade college-aspiring students with twelfth grade students scoring approximately 1/2 of a standard deviation higher than tenth grade students ($d = .51$). There were small differences between twelfth and eleventh grade students' scores ($d = .45$) and between eleventh and ninth grade students' scores ($d = .27$) among the students with plans to attend college.

Table 4.19

Grade Level by Aspirations Analysis of Variance Summary Table for KTKS

Source	*df*	Sum of Squares	Mean Square	*F*
Grade level	3	18.38	6.13	7.44*
Aspirations	3	390.27	130.09	157.91*
Grade level by aspirations	9	36.39	4.04	4.91*
Error	4633	3816.78	0.82	
Total	4648	4491.02		

*$p < .01$

For the students who planned to work after high school, there were significant differences in KTKS scores between twelfth grade students and all of the other grades with twelfth grade students scoring approximately 2/5 of a standard deviation higher than students in the other grades. There were no significant differences in scores among grades nine through eleven. For the students who responded *Other* or *Don't Know*, there were no significant differences in scores over grade level. Table 4.20 describes KTKS scores by students' aspirations by grade level.

Table 4.20

Descriptive Statistics for KTKS by Aspirations and Grade Level

	Ninth (n = 1,243)		Tenth (n = 1,360)		Eleventh (n = 1,036)		Twelfth (n = 1,010)	
Grade	M	SD	M	SD	M	SD	M	SD
College	3.09^{a}	0.87	3.30^{b}	0.85	3.54^{c}	0.82	3.80^{d}	0.86
Career	2.76^{e}	1.07	2.76^{e}	0.94	2.80^{e}	1.08	3.16^{f}	1.01
Other	2.73^{g}	1.09	2.75^{g}	0.93	3.04^{g}	0.89	2.55^{g}	1.53
Don't Know	2.57^{h}	1.00	2.50^{h}	0.93	2.56^{h}	1.10	2.75^{h}	1.16

Note. Group means sharing a common superscript within a row are not significantly different ($p < .01$).

There were large differences in KTKS scores between twelfth grade students who aspired to attend college and students who responded *Other* or *Don't Know*: twelfth grade students with college plans scored more than one standard deviation higher than students who responded *Other* (d = 1.28) and who responded *Don't Know* (d = 1.07). Twelfth

grade students with college plans scored 2/3 of a standard deviation higher on the KTKS than twelfth grade students who planned to work (d = .65). There were also medium-sized differences in KTKS scores between twelfth grade students who aspired to work and the students who responded *Other* (d = .62). There were no statistically significant differences among the other groups of twelfth grade students (Table 4.21).

There was a large difference in KTKS scores between eleventh grade students who aspired to attend college and those who responded *Don't Know* (d = .99) and medium sized differences between college going eleventh grade students and students who planned to work (d = .75) and those who responded *Other* (d = .51). There were no statistically significant differences among the other groups of eleventh grade students. This trend was consistent in ninth and tenth grades with the students in those grades who had college plans scoring statistically significantly higher than the students with different aspirations and no significant differences among the other groups. Table 4.21 describes KTKS scores by aspirations over grade levels.

Table 4.21

Descriptive Statistics for KTKS by Grade Level and Aspirations

	College (n = 3,303)		Career (n = 777)		Other (n = 204)		Don't Know (n = 365)	
Grade	M	SD	M	SD	M	SD	M	SD
Ninth	3.09[a]	0.87	2.76[b]	1.07	2.73[b]	1.09	2.57[b]	1.00
Tenth	3.30[c]	0.85	2.76[d]	0.94	2.75[d]	0.93	2.50[d]	0.93
Eleventh	3.54[e]	0.82	2.80[f]	1.08	3.04[f]	0.89	2.56[f]	1.10
Twelfth	3.80[g]	0.86	3.16[h]	1.01	2.55[i]	1.53	2.75[hi]	1.16

Note. Group means sharing a common superscript within a row are not significantly different (p < .01).

Key Content Knowledge. There were no significant differences by grade for Key Content Knowledge (KCK) and so I analyzed the differences in student scores in this Key using a one-way, between-subjects analysis of variance with aspirations as the independent variable and the dependent variable was KCK scores. The effect of aspirations on students' Key Content Knowledge (KCK) scores was significant (Table 4.22). Over all grades, students who aspired to attend college scored significantly higher than the students who planned to work (d = .64), had *other* plans (d = .62), or who did not know their plans for after high school (d = .49). There were no statistically significant differences in KCK scores among other groups of students. Tables 4.17 and 4.22 present the results of these analyses.

Table 4.22

Grade Level by Aspirations Analysis of Variance Summary Table for KCK

Source	*df*	Sum of Squares	Mean Square	*F*
Aspirations	3	196.13	65.38	105.38*
Error	4645	2881.56	0.62	
Total	4648	3077.69		

*$p < .01$

Key Learning Skills and Techniques. As with the KCK, there were no significant differences by grade for Key Learning Skills and Techniques (KLST) and so I analyzed the differences in student scores in this Key using a one-way, between-subjects analysis of variance with aspirations as the independent variable and the dependent variable was KLST scores. The effect of aspirations on students' KLST scores was significant (Table 4.22). I conducted post-hoc comparisons using the Tukey HSD test, over all grades students who aspired to attend college scored significantly higher than the students who planned to work (d = .75), had *other* plans (d = .67), or who did not know

their plans for after high school (d = .55). There were no statistically significant differences in KLST scores among other groups of students. Tables 4.17 and 4.23 present the results of these analyses.

Table 4.23

Grade Level by Aspirations Analysis of Variance Summary Table for KLST

Source	*df*	Sum of Squares	Mean Square	*F*
Aspirations	3	262.77	87.59	138.13*
Error	4645	2945.47	0.63	
Total	4648	3208.24		

*p < .01

Grade Point Average

The sixth research question was, "What are the relationships between students' CampusReady scores and their high school GPA? How do these relationships differ by grade level?" The hypothesis for this research question was that, based on the review of the literature, CampusReady scores and GPA would have moderate positive relationships because related constructs had moderate positive relationships with GPA. This research question was addressed by correlating students' CampusReady scores for each key with their self-reported GPA. Because students' college and career preparation should improve as they approach high school graduation, the correlations between students CampusReady scores and their GPA were examined by grade. As noted in the third chapter, this analysis excluded students who did not complete CampusReady and only included students from schools using a 0-4.0 grading scale. Table 4.24 displays GPA overall and by grade level.

Table 4.24

Student Grade Point Average Overall and By Grade for Survey Completers from Schools on 0-4.0 Grading Scale

Grade Level	*n*	Grade Point Average	
		M	*SD*
Overall	2,483	2.74	0.97
Ninth	651	2.66	1.09
Tenth	624	2.76	1.00
Eleventh	584	2.76	0.91
Twelfth	624	2.77	0.84

Note. The distribution of GPA is symmetrical with no severe outliers.

Overall the grades, there was a medium sized relationship between students' KLST scores and their GPA, and small relationships between students' GPA and their scores in the KCS, KCK, and KTKS according to Cohen's (1992) effect size strength criteria. When analyzed by grade, there were medium sized relationships between ninth grade students' GPA and their KCS and KLST scores. There were also medium sized relationships between eleventh grade students' GPA and their scores in each Key. The rest of the relationships between GPA and CampusReady scores within each grade were small.

Table 4.25 presents the results of the correlations between the Four Keys and GPA by grade and overall for the schools with a 4.00 grading scale.

Table 4.25

Correlations between the Four Keys and GPA by Grade and Overall for Schools with 4.00 Grading Scale

Key	Ninth (n = 651)	Tenth (n = 624)	Eleventh (n = 584)	Twelfth (n = 624)	All (n = 2,483)
KCS	.35	.25	.31	.24	.29
KCK	.28	.26	.32	.22	.27
KLST	.34	.28	.34	.26	.31
KTKS	.22	.23	.33	.34	.27

Notes. KCS = Key Cognitive Strategies; KCK = Key Content Knowledge; KLST = Key Learning Skills and Techniques; KTKS = Key Transition Knowledge and Skills. All correlations in this table are significant ($p < .01$)

Summary

Table 4.26 summarizes the research questions, hypotheses, and results. The implications and limitations of these results are presented in the next chapter, along with a discussion of future directions for CampusReady validation and the assessment of metacognitive learning skills.

Table 4.26

Research Questions, Hypotheses, and Results

Research Questions	Hypotheses	Results
1. Do CampusReady (CR) scores differ significantly by grade level?	• Student grade level would have an effect on scores • Older students would have significantly higher scores than younger students • Largest difference between 9^{th} and 12^{th} grade.	• Small and medium effects of grade level on KCS and KTKS scores • No effects on KCK or KLST scores
2. Do CR scores differ significantly based on students' race/ethnicity and does that effect depend on grade level where grade level had a significant effect on CR scores?	• Race/ethnicity would have no effect on scores	• No grade level-by-race interaction effect in KTKS or KCS • Effect sizes do not even rate as small
3. Do CR scores differ significantly based on students' mother's education and does that effect depend on grade level where grade level had a significant effect on CR scores?	• Mother's education would have no effect on scores	• No grade level-by-mother's education interaction effect in KTKS or KCS • Medium effects in each Key • Students whose mothers attended graduate school or college tended to score higher than other students
4. Do CR scores differ significantly based on students' first language and does that effect depend on grade level where grade level had a significant effect on CR scores?	• First language would have no effect on scores	• No grade level-by-first language interaction effect in KTKS or KCS • No effects in each Key

Table 4.26

Research Questions, Hypotheses, and Results (cont.)

Research Questions	Hypotheses	Results
5. Do CR scores differ significantly based on students' post-high school aspirations and does that effect depend on grade level where grade level had a significant effect on CR scores?	• Aspirations would have small to medium sized effects on scores • Higher scores for students who aspired to attend college than for students with other plans	• Grade level-by-aspirations interaction effect in KTKS but not KCS • Large and medium sized effects within and across grade levels and aspirations for KTKS • Medium effects in other Keys
6. What are the relationships between students' CR scores and their high school GPA? How do these relationships differ by grade level?	• Grade point average would have small to medium sized relationships with scores • Larger correlations for older students than younger students	• Over all grades, small and medium relationships between GPA and CR scores • Medium relationships for 9^{th} and 11^{th} grades; small relationships for other grades

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study is to examine the evidence underlying the basic claim behind CampusReady, which is that scores can be interpreted as valid indicators of college and career readiness. I examined this evidence through the argument-based, or unified, approach to validity in which practical arguments are used to build a clear, coherent, and plausible argument regarding appropriate test interpretation (Kane 1992, 2001). Through this approach, the inherent assumptions underlying score interpretation are identified and the best possible evidence is collected to examine those assumptions.

I used six categories of inference to organize the validity argument made in this study: theory-based inferences, observation, technical inferences, generalization, decision-based inferences, and extrapolation. I then developed six statements describing CampusReady assumptions that are related to each of these categories of inference and used them as a lens through which to examine the validity of CampusReady score interpretation. Through this process, I identified the extant evidence supporting each assumption and generated preliminary additional evidence through the analyses designed to address the research questions.

First, this chapter summarizes the results of the research questions, limitations, and future directions for collecting evidence of the validity of CampusReady score interpretation. Next, this chapter discusses those results in the context of the six framing assumptions used to organize the validity argument. This chapter concludes with a discussion of potential of triangulating different sources of information about student

college and career readiness by triangulating the results of measures like CampusReady with other information about students.

Answers to the Research Questions

Grade Level

The first research question was, "Do CampusReady scores differ significantly by grade level?" I hypothesized that students' grade level would have an effect on CampusReady scores with higher scores for older students. Where there were statistically significant effects of grade level on CampusReady scores, I controlled for grade level in the analyses used to address research questions two through five.

There were medium sized differences in Key Transition Knowledge and Skills (KTKS) scores with twelfth grade students scoring 2/3 of a standard deviation higher than ninth grade students (d = .66). There were small differences in Key Cognitive Strategies (KCS) scores across the grade levels with the largest difference between ninth and twelfth grade students' scores (d = .37). Contrary to my hypothesis, there were no significant differences by grade level for Key Content Knowledge (KCK) or Key Learning Skills and techniques (KLST). Due to these results, I included grade level as a covariate in subsequent analyses for KCS and KTKS but not for KCK or KLST.

Background Characteristics

Research questions two through four examined the evidence of the consequential validity of CampusReady by inquiring into the differences in CampusReady scores based on students' background characteristics including race/ethnicity, mother's education, and first language. Based on the results of the grade level analyses used to address research question one, I included grade level as a covariate in the ANOVAs in order to determine

whether or not the effect of background characteristics depended on grade level for Key Cognitive Strategies KCS and KTKS scores.

There were no grade-by-race interaction effects on KCS or KTKS scores. Student race/ethnicity did have statistically significant main effects on CampusReady scores, however the effect of race/ethnicity on CampusReady scores in each Key did not even rate as small according to Cohen (1992). The African American and Native American/Alaska Native group tended to score higher than the other groups, followed by the group of White and Asian American/Pacific Islander students, and the Hispanic/Latino students tended to score lower on CampusReady than the other groups.

There were no grade-by-mother's education interaction effects on KCS or KTKS scores. Mother's education did have medium sized effects on CampusReady scores for this sample of students. Students who did not know their mother's education scored lower on each Key than the other groups and the largest differences were between that group and students whose mother's had attended graduate school (Table 4.7). There were small or no significant differences in CampusReady scores between students whose mothers had attended college and students whose mothers had attended graduate school. Unlike the other background characteristics examined, first language did not have statistically significant effects on CampusReady scores and there were no grade-by-first language interaction effects on KCS or KTKS scores (Table 4.12).

Aspirations

The fifth research question was, "Do CampusReady scores differ significantly based on students' aspirations for after high school and does that effect depend on grade level where grade level had a significant effect on CampusReady scores?" I hypothesized

that there would be small to moderate effects of students' aspirations for after high school on CampusReady scores, with higher scores for students who aspired to attend college than for students with other plans. This research question sought to explore the consequential validity evidence of CampusReady scores to examine the assumption that students with higher CampusReady scores are more prepared for college and careers than other students.

There was a significant grade-by-aspirations interaction effect on KTKS scores but not on KCS scores. There were large differences in KTKS scores between twelfth grade students who aspired to attend college and students who responded *Other* or *Don't Know*: twelfth grade students with college plans scored more than one standard deviation higher than students who responded *Other* (d = 1.28) and who responded *Don't Know* (d = 1.07). There was also a large difference between eleventh grade students who aspired to attend college and those who responded *Don't Know* (d = .99). Twelfth grade students with plans to attend college scored almost 3/4 of a standard deviation higher than ninth grade students with college plans on the KTKS, which measures student's awareness of the process of enrolling in college and entering careers. In the other Keys, aspirations for after high school had medium sized effects on CampusReady scores with students who aspired to attend college scoring higher than the other groups of students.

Grade Point Average

The sixth research question was, "What are the relationships between students' CampusReady scores and their high school grade point average (GPA)? How do these relationships differ by grade level?" The hypothesis for this research question was that, based on the review of the literature, CampusReady scores and GPA would have

moderate positive relationships band that these relationships would be stronger for older students. Like research question five, the answers to this research question sought explore to preliminary consequential and criterion-related validity evidence of CampusReady student score interpretation to support the assumption that students who score higher on CampusReady are more prepared for college. This research question was addressed by correlating students' CampusReady scores for each key with their self-reported GPA.

Over all the grades, there was a medium sized relationship between students' KLST scores and their GPA, and small relationships between students' GPA and their scores in the KCS, KCK, and KTKS according to Cohen's (1992) effect size strength criteria. When analyzed by grade, there were medium sized relationships between ninth grade students' GPA and their KCS and KLST scores. There were also medium sized relationships between eleventh grade students' GPA and their scores in each Key. The rest of the relationships between GPA and CampusReady scores within each grade were small.

Limitations of the Results and Future Directions

These results provided preliminary evidence supporting the interpretation of CampusReady scores as indicators of students' readiness for college and careers when used as a low-stakes diagnostic measure of the Four Keys. Further evidence of the validity of the tool should be collected to support new decision-based inferences or if CampusReady were to be used in a higher-stakes context, such as to make placement decisions about students.

One of the concerns related to the use of CampusReady, or other self-report assessments, for high-stakes decision-making relates to the high susceptibility of these measures to *impression management* (also known as *socially desirable responding* or *faking*), which also has implications for the validity of the measures (Hogan, Barrett, Hogan, 2007). One side of this debate is that individuals cannot communicate accurately about ourselves, thus all self-reported data is inherently flawed; others argue that individuals attempt to maximize acceptance by consciously or subconsciously creating a favorable impression of ourselves in our responses to self-report items (Ellingson, Smith, & Sacket, 2001; Hogan, Barrett, Hogan, 2007).

There is evidence that faking may not threaten the validity of noncognitive measures used in low stakes scenarios (Ellingson, Smith, & Sacket, 2001; Hogan, Barrett, Hogan, 2007). For instance, in analyses of four widely used personality tests (the ABLE, CPI, 16PF, and HPI), socially desirable responding did not alter the factor structure of the measures (Ellingson, Smith, & Sacket, 2001). Despite these promising results, many experts caution that that these measures should only be used in conjunction with cognitive measures if used for high stakes decision-making (Morgeson, et al., 2007; Schmidt & Hunter, 1998).

Another limitation of this study is that the sample for this study was drawn from the participants in the 2012-13 administration of CampusReady. As it was a non-random convenience sample, the generalizability of the results of this study is limited to the 4,649 students from nineteen schools who completed CampusReady in 2012-13. Although exploratory and descriptive, these results can suggest a course of inquiry into collecting

other evidence of the validity of using CampusReady scores to measure student college and career readiness.

The differences in completion rates for student subgroups are another limitation of the sample that indicate that when compared to the overall sample of CampusReady participants, the analytic subsample of survey completers overrepresents twelfth grade students, American Indian/Alaska Native and White students, students who reported that English was their first language, and students whose mothers were high school graduates or who had less education. In order to confirm the results of the analyses designed to explore the consequential validity of CampusReady, follow up studies should be conducted on a sample of students that is nationally representative, particularly for the characteristics examined including grade level, grade point average, race/ethnicity, mother's education, and first language. The next sections discuss the limitations of the results of the research questions and present suggestions for future research.

Grade Level

Grade level had small and medium sized effects on Key Cognitive Strategies (KCS) and Key Transition Knowledge and Skills (KTKS) scores but not on Key Content Knowledge (KCK) or Key Learning Skills and Techniques (KLST) scores. More research is needed to determine whether or not these results indicate that twelfth grade students acquire the skills and dispositions measured by the KTKS and KCS CampusReady subscales between ninth and twelfth grade—but not for the KCK and KLST CampusReady subscales—or if these results are due to the limitations of this sample. Such follow up studies could inquire into the types of opportunities students have in high school to learn about the steps needed to enroll in college and enter career fields after

high school, to develop thinking skills and the mindsets that foster learning, and to adopt learning strategies and study skills.

Background Characteristics

There were no grade level-by-background characteristics interaction effects for the background characteristics explored in this study including race/ethnicity, mother's education, and first language. Race/ethnicity had such small effects on student scores they would not even rate as small according to Cohen and first language had no significant effect on scores. Mothers' education was the only background characteristic explored that did effect student's scores and there were medium effects of mother's education on student scores in each Key.

The African American and American Indian/Alaska Native students in this sample tended to score highest in each Key. Although small effects, they were contrary to expectations in that these groups of students tend to have the lowest college enrollment rates and so were not expected to excel on a measure of students' readiness for college. These results may be attributable to the characteristics of the sample, which included students from schools and programs targeted at improving the college and career readiness of African American students. CampusReady was administered to these students in the fall, prior to their completion of the intervention programs, nevertheless this sample may have included African American students who have developed higher-than average college and career readiness skills.

There were medium sized effects of mother's education on CampusReady scores. This result, if confirmed in a representative sample, could indicate two possible scenarios: the measure is biased due to construct underrepresentation, construct irrelevant

variance, or another technical defect of the tool; or the result is due to construct relevant variance and there are real differences in CampusReady scores based on mother's education. These results indicate that students who do not know their mothers' education scored lower on CampusReady than other students and the highest scoring students were those whose mothers attended college or graduate school. Given that the tool measures readiness for college and careers, it may be that there are true score differences among students based on their mother's education because the students whose mothers did attend college are learning something related to college and career readiness at home that the other students are not learning.

Another limitation to these results is the low survey completion rate for students whose first language was not English. As discussed in the third chapter, only 70% of students who responded that English was not their first language and 64% of students who did not know their first language completed the survey and those differences in survey completion rates were significant ($p < .01$). More research is needed to determine if the higher completion rates for students whose first language is English is due to a bias in CampusReady, administration issues, or other potential explanations such as low English literacy. If the lower completion rates for these students are due to their English literacy, EPIC should suggest to schools that English Language Learners be given more time to complete the survey or other accommodations.

If significant differences in CampusReady scores exist based on student's background characteristics in a representative sample, more research is needed to determine whether the differences are construct relevant and due to real differences in students' abilities in the Four Keys based on background characteristics or a bias in

CampusReady. As discussed in the second chapter, the race- and family income-based achievement gap persists through K-12 education and into college and careers. CampusReady score differences based on background characteristics could be true score differences and another outcome of the complex milieu of social forces contributing to the achievement gap. However, if differences by background characteristics are observed in a representative sample, Item Response Theory (IRT) should be used to review potential sources of bias at the item level.

Another study should explore the interplay between race/ethnicity and first language. Students whose first language was not English or who did not know their first language scored lower on CampusReady than students whose first language was English, and Hispanic/Latino students also scored lower on CampusReady than other groups. Many of the schools in this sample were located in the American southwest in schools with large populations of Hispanic/Latino students and English Language Learners. It is possible that these groups overlap and follow up studies could determine whether there are significant race-by-first language interaction effects on CampusReady scores. Because generational educational attainment differs by race, there may also be a race-by-mothers' education interaction effect that should be explored in a representative sample of students.

Aspirations

As predicted, students' aspirations did effect CampusReady scores and some differences by aspirations were quite large. This finding, if confirmed in a representative sample, lends preliminary evidentiary support for the claim that there is a relationship between students' CampusReady scores and their preparation for college and careers in

that higher-aspiring students tend to score higher on CampusReady. If these students go on to achieve their college aspirations, it would be further evidence that there is a relationship between students' CampusReady scores and their aspirations.

One limit of these findings is their directionality, this analysis examined the differences in CampusReady scores by students' aspirations and cannot be interpreted as resulting in a finding that higher scoring students will have higher aspirations. Rather this finding might be explained by the possibility that because of their college plans, higher aspiring students are engaging in obtaining information that will prepare them for college and so score higher. Another possibility is that those students who aspire to attend college have more self-confidence and may tend to rate themselves higher on measures like CampusReady.

A stronger argument for the validity of CampusReady scores would be made with evidence of the predictive validity of CampusReady. In order to collect more evidence of the predictive validity of CampusReady, EPIC could collect longitudinal data on participating students such as their first year college GPA, graduation and employment rates. Students could be tracked against their aspirations to determine if they achieved their plans for after high school. These longitudinal data would provide evidence of how well students' CampusReady scores predict later success in college and careers.

Grade Point Average

There were small and medium relationships between CampusReady scores in each Key and students' self-reported grade point average (GPA). No clear pattern emerged when this analysis was repeated for each grade, there were medium-sized relationships with GPA for 9th and 11th grade students but small effects for the other

grades. As discussed, impression management is a limitation to all of these results but this one in particular. Self-reported GPA may not be reliable for a number of reasons including students' lack of self-awareness, the point of time the question is asked (a student in the fall administration may report their GPA from the previous year whereas a student in the spring administration might report their fall GPA), and any number of other issues including impression management.

EPIC should conduct follow-up analyses using student-level data reported by the school, not the students. For instance, EPIC could analyze the relationships between students' CampusReady scores and their school-reported GPA, college admissions test scores (PLAN/ACT, PSAT/SAT), and scores on other measures of college and career readiness (e.g., the Common Assessments, or AP exams) to provide additional evidence that CampusReady scores can be used as indicators of students' readiness for college or careers.

Validity Inferences and Assumptions

The measurement of metacognitive learning skills is a timely topic among those involved in assessment and college and career readiness. As chapter two discusses, there is support for the inclusion of metacognitive learning skills in college and career readiness models such as the Four Keys and as the findings suggest, there is preliminary evidence supporting the use of CampusReady scores as indicators of student college and career readiness. The foundational theory-based inference behind this claim rests on the assumption that the theoretical model on which it is based, the Four Keys, represents constructs associated with success in college and careers. This assumption is supported by the review of the literature, which suggests that similar constructs to the Four Keys are

related to student outcomes such as K-12 student achievement, college GPA, retention, and job proficiency.

There is preliminary evidence from two factor analyses supporting the second assumption underlying CampusReady score interpretation, which is that CampusReady measures the Four Keys (Lombardi, Conley, Seburn, Downs, 2013; Lombardi, Seburn, & Conley, 2011a). The third assumption underlying CampusReady score interpretation is that CampusReady scores are generalizable across items, scorers, and occasions. The appendix presents reliability statistics for CampusReady subscales, Cronbach's α (alpha) resulted in reliability coefficients of approximately 0.80 for most subscales.

The fourth assumption, which is that CampusReady scores are free of sources of systematic error that would bias interpretation of scores as indicators of student college and career readiness, was explored through research questions two through four by examining the differences in CampusReady scores based on students race/ethnicity, mothers' education, and first language. These research questions sought to explore the consequential validity evidence of CampusReady by examining the differences in scores between subgroups of examinees. Again, these analyses should be repeated on a representative sample of students and, where subgroup differences exist, follow up studies should be conducted to look for evidence of construct underrepresentation or construct irrelevant variance in the measure. Attempts should also be made to determine if the results are due to true differences among students based on their background characteristics, rather than a bias of the tool.

The fifth assumption supporting CampusReady score interpretation is that there is a relationship between students' scores and their preparation for college and careers. The

fifth and sixth research questions in this study addressed this assumption by examining the relationships between students' CampusReady scores and their aspirations for after high school and their GPA to provide concurrent criterion-related evidence demonstrating the relationship between CampusReady and other indicators of college and career readiness. Follow up studies with a representative sample and using longitudinal data or data provided by the schools should be conducted to confirm these results.

Triangulating College and Career Readiness

The practical significance of this study is that it helps move understanding of student self-reports on college readiness as a potential data source for expanded profiles of readiness. The triangulation of information about students' college and career readiness including data obtained from traditional measures like grade point average and college placement exams, in conjunction with information about students' aspirations and their metacognitive learning skills shows the most promise for preparing students for postsecondary success.

Conley and Darling-Hammond (2013) argue that a system of assessments, rather than an assessment system, has the potential to measure all of the knowledge, skills, and dispositions required for postsecondary success. In such a system, a continuum of content-based assessments, self-report measures, and performance assessments would be used for both formative and summative purposes to inform learning and teaching and to measure school improvement. Low-stakes formative assessments would provide feedback "to students on where they stand relative to the goal of being college- and career-ready, not with the intent of classifying them or withholding a benefit, such as access to a particular program, curriculum, or diploma" (Conley & Darling-Hammond,

2013, p. 5). Further, such a system would allow students to demonstrate their abilities in multiple ways beyond a single cut score; “cut scores generally, and a single cut score in particular, are not valid as the basis for high-stakes decisions about individual students” (Conley & Darling-Hammond, 2013, p. 33).

CampusReady along with the consortia assessments developed to measure the Common Core can be used in combination to triangulate student preparation for college and careers. Results of these measures would be compiled into student profiles that demonstrate students’ college and career readiness via portfolios of work products including performance tasks, teacher ratings on classroom work, test results, and students’ interests and aspirations for after high school (Conley & Darling-Hammond, 2013). These portfolios could be used to provide actionable information to students about the knowledge, skills, and abilities they need to cultivate to be prepared for their aspirations. Further, this triangulated information could be provided to universities to help make decisions for admissions, course placement, and the identification of students who would benefit from remedial education.

The risk of this type of panacea approach to assessment is that the validity of the measures used in such a system hinges on each interpretation of results because a test that is valid for one purpose may not be valid for a different one. The evidence supporting the different interpretations of the results of these measures must be thoroughly examined, particularly if the same tool is used for both formative and summative purposes, and a validity argument, such as the one articulated here, must be constructed for each different use of these measures. This is particularly important if they are be used for school accountability purposes so that they support and do not undermine school improvement

efforts. Although this endeavor is ambitious, it may lead to better measurement of student abilities and, more importantly, better learning gains for students as they prepare for adulthood.

APPENDIX

RELIABILITY

Table A.1

Reliability of Key Cognitive Strategies Subscales

Scale	Subscale	*n* of Items	Alpha (α)
Communication	Construct	5	0.86
	Organize	5	0.83
Interpretation	Analyze	4	0.83
	Evaluate	5	0.89
Precision and Accuracy	Confirm	5	0.88
	Monitor	5	0.84
Problem Formulation	Hypothesize	5	0.86
	Strategize	6	0.87
Research	Collect	4	0.82
	Identify	5	0.84

Educational Policy Improvement Center (2013)

Table A.2

Reliability of Key Content Knowledge Subscales

Scale	Subscale	*n* of Items	Alpha (α)
Academic Attribution	ELA	3	0.70
	Math	3	0.74
	Science	3	0.72
	Social Studies	3	0.73
	Technology	3	0.73
Academic Value	ELA	5	0.86
	Math	5	0.87
	Science	5	0.89
	Social Studies	5	0.87
	Tech	5	0.87
Challenge Level	ELA	2	0.78
	Math	2	0.78
	Science	2	0.76
	Social Studies	2	0.76
	Technology	2	0.78
General Key Content Knowledge	General Challenge	3	0.84
	Experience w/Technology	5	0.77
	Structure of Knowledge	9	0.91
Student Effort	ELA	4	0.83
	Math	4	0.83
	Science	4	0.83
	Social Studies	4	0.83
	Technology	4	0.84

Educational Policy Improvement Center (2013)

Table A.3

Reliability of Key Learning Skills and Techniques Subscales

Scale	Subscale	*n* of Items	Alpha (α)
Self-Monitoring	Goal Setting	10	0.91
	Persistence	9	0.88
	Self-Awareness	8	0.86
Learning Strategies	Collaborative Learning	5	0.79
	General Study Strategies	4	0.82
	Information Retention Strategies	6	0.83
	Note Taking	8	0.90
	Strategic Reading	5	0.87
	Test Taking	7	0.83
	Time Management	11	0.91

Educational Policy Improvement Center (2013)

Table A.4

Reliability of Key Transition Knowledge and Skills Subscales

Scale	Subscale	*n* of Items	Alpha (α)
Academic Awareness	College and Career Expectations	6	0.82
	College and Career Preparation	9	0.82
College Admissions Process	College Application	5	0.82
	College Selection	5	0.90
College and Career Culture	Career Awareness	9	0.86
	College Awareness	5	0.89
Tuition and Financial Aid	Financial Aid Awareness	6	0.89
	Tuition Awareness	4	0.92

Educational Policy Improvement Center (2013)

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