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A study of the influence of student engagement on community college students' intentions to transfer and STEM aspirations

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Dedication

This dissertation is dedicated to my family.

To my husband, Chris, who provided me with emotional support and encouragement throughout this degree. Thank you for putting our lives on hold for me to reach my goals. To my parents, Dana and Jerry, for always believing in me and pushing me to strive to be the very best. Thank you for giving me opportunities to reach my dreams and see the world. I would not be where I am today without you. To my nephews and nieces, treasure your education and enjoy the experiences that life provides you.

I love you all.

Listen to the MUSN'TS, child,

Listen to the DON'TS

Listen to the SHOULDN'TS

The IMPOSSIBLES, the WON'TS

Listen to the NEVER HAVES

Then listen close to me –

Anything can happen, child,

ANYTHING can be

-Shel Silverstein

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ABSTRACT

Community colleges serve as the college of choice for nearly half of all postsecondary students. The role of the community college continues to adapt and change, and the colleges that were once seen as vocational and technical schools now serve as a jumping off point to future educational endeavors and a variety of careers and occupations. Community colleges are aware of their increased role in postsecondary education and understand that they must continue to study their students and adapt to their needs to stay at the educational forefront.

This study was conducted at the 15 community college districts in Iowa with the intention to develop a deeper understanding of the influence of student engagement on community college students' intentions to transfer and STEM aspirations. The study used the new STEM Student Success Literacy survey instrument. The purpose of this study was threefold: (a) to understand the demographic characteristics and engagement practices of students attending Iowa community colleges; (b) to understand the influence, if any, of engagement on students' intentions to transfer to a 4-year institution and on students' STEM aspirations; and (c) to add to the current body of literature on engagement, specifically community college engagement. A review of the literature study on student engagement and community college engagement led to the development of six research questions that guided this study. Alexander Astin's (1993) theory of student involvement and John Weidman's (1989) model of undergraduate socialization were used as the theoretical framework to guide this study.

This analysis found that statistically significant differences exist for variables associated with students' background, enrollment status, and level of engagement between

students with transfer intentions and those without transfer intentions and between students with STEM aspirations and those without STEM aspirations. A community college student engagement model was established through the use of an exploratory and confirmatory factor analysis. The model consisted of four engagement constructs: Peer Engagement, Transfer Engagement, Faculty/Staff Encouragement/Assistance and Faculty Engagement on Coursework. Two logistic regression analyses revealed statistically significant indicators of students' intentions to transfer and STEM aspirations. This dissertation concludes with a discussion of the findings, implications for policy and practice, and recommendations for future research.

CHAPTER 1. INTRODUCTION

Introduction

Community colleges serve as tremendous educational stepping stones for students seeking to transfer to a 4-year college or university, as the community colleges assist the students in acclimating to the college environment, developing positive study habits (Rendon, 1994), and allowing them to attain a well-rounded education at an affordable price (Obama, 2011). As tuition rates continue to rise at public and private 4-year institutions, more students than ever before in the history of the United States are choosing community colleges as the place to begin their postsecondary education. The number of students attending and completing associate's degrees at 2-year colleges rose by more than 50% between the 1999–2000 and 2009–10 academic years (National Center for Education Statistics [NCES], 2012).

Although more students are attending community college than ever before in the history of the community college system, funding for all higher education has begun to wane. With state and federal governments experiencing financial shortfalls, budgets are being cut and revised on a regular basis. Unfortunately, higher education is an area that often experiences budget reductions at faster rates than do other educational sectors. As community college funding levels decrease at both the state and the national level, the call for increased accountability has led to further research on the influences of student persistence. The No Child Left Behind Act of 2011 is one example of recent legislation that has called for an increase in accountability at all levels of education, including the community colleges. The passing of the No Child Left Behind Act of 2001 called for increased student-test scores, retention, completion, and graduation rates and has led many states to move toward a performance-based funding system (No Child Left Behind Act of 2001).

At a time when STEM-related jobs are at an all-time high, community colleges are playing an integral role in educating STEM students. Community colleges provide underrepresented minorities (URMs) and female students with pathways to a STEM education that they may not have had at a 4-year college or university (Brazziel & Brazziel, 1994; Laanan, 2001; Starobin & Laanan, 2008; Tsapogas, 2004). Community colleges are playing a larger role in STEM education than ever before in history. In 2011, nearly half of all STEM graduates in the fields of science, engineering, and health had completed at least one community college course at some point in their education (Mooney & Foley, 2011; Reyes, 2011).

Studies on student engagement have found that the students' collegiate environment heavily influences their college outcomes (Astin, 1984, 1993; Kuh, Kinzie, Schuh, & Whitt, 2010; McClenney, Marti, & Adkins, 2012; Pascarella & Terenzini,1991, 2005; Tinto, 1998). Community colleges can assist students in completing their intended degrees by offering opportunities for students to engage with their peers and faculty members in both academic and social settings. These engagement opportunities help students foster relationships that can not only assist the students in completing coursework, but can also act as a support system when times get tough.

Current State of STEM Education in the United States

In President Obama's (2011) State of the Union Speech, he noted, "America has fallen to ninth in the proportion of young people with a college degree" (para. 34). In his goals for improving education, the president mentioned that community colleges are an integral aspect of the U.S. educational system. Through the community college system, higher education is available to many who could not otherwise afford to attend a more expensive college or university, attend class during the day, or move to a new location simply to attend college. The community college can be the way to a better-educated American public, and it definitely can be a means to improve the graduation rate of all students attending colleges and universities in the United States.

Just as the United States has fallen behind the rest of the world in the proportion of college degrees that are completed each year, it is also falling behind other nations in the proportion of STEM degrees attained. In the Congressional Research Service's Report for Congress, *Science, Technology, Engineering, and Mathematics (STEM) Education: Background, Federal Policy, and Legislative Action* (Kuenzi, 2008), it was noted that the United States currently ranks 20th in the world in the percentage of 24-year-olds with degrees in a natural science or engineering field. Collectively, postsecondary institutions in the United States awarded 2.5 million degrees in the 2002–03 academic year, and less than 16% of those degrees were awarded to students with majors in STEM-related fields. Of the STEM degrees, 14.6% of those were associate's degrees, 16.7% were baccalaureate degrees, 12.9% were master's degrees, and 34.8% were doctoral degrees. The Report for Congress (Kuenzi, 2008) also noted that the United States ranks second to last in the percentage of STEM degrees awarded when compared to countries that award more than 200,000 degrees annually. This disparity between the United States and the other countries in the study is a reason to be very concerned about the future of the nation's educational system as well as the future of United States STEM-related careers in the global marketplace. At a time when jobs in STEM-related fields are being outsourced at a higher rate than ever before, it is imperative that the United States produce highly educated graduates to fill all available positions and limit the need for outsourcing to other countries (Kuenzi, 2008).

If the United States truly seeks to regain the leadership role that it once held in the education of STEM students, it must first retain the students that enter college every year and guide them to a major in a STEM field. In the last decade, very little data have been collected on the completion, retention, and graduation rates of STEM students, especially students transferring from community colleges to 4-year institutions. However, two studies conducted on the topic found that STEM students complete degrees at a much lower rate than do non-STEM students, even when given 5 years to complete the degree (Scott, Tolson, & Huang 2009; Whalen & Shelley, 2010).

Current State of STEM Education in the State of Iowa

In 2011, the state of Iowa and Governor Branstad began the process of taking an in-depth look at the state of STEM education in Iowa. What the Iowa Governor's STEM Advisory Council found was that a state that once prided itself on education in STEM fields had begun to lag behind states that they once outperformed (Clayworth, 2012; Iowa Governor's STEM Advisory Council, 2011). Perhaps the most eye-opening evidence of Iowa's decrease in STEM education was the realization that a large percentage of Iowa students are not prepared to take math (50%) or science (37%) at the college level (Iowa Mathematics and Science Educational Partnership [IMSEP], 2011).

A 2009 study by the Iowa Mathematics and Science Educational Partnership concluded that the state of Iowa lags behind the national average in the proportion of undergraduate degrees and credentials awarded in STEM fields. The proportion of STEM credentials awarded at Iowa's postsecondary institutions comprised 10.9% of all degrees and credentials awarded during the 2009 academic year, whereas the national average for STEM degrees and credentials was 12.3% (IMSEP, 2009).

As a result of the in-depth analysis of the state of STEM education in Iowa, several STEM initiatives were established. The Iowa Governor's STEM Advisory Council, the Iowa STEM Education Roadmap, and the Iowa STEM Equity Pipeline were established to improve the quality of STEM education. The Iowa STEM Equity Pipeline seeks to increase the number of females and minority students in STEM fields, whereas the Iowa Governor's STEM Advisory Council intends to improve the availability of STEM education to students and families throughout the state. The STEM Education Roadmap includes seven indicators that will guide the future of STEM education policy in the state. These initiatives include:

1. Increased interest and performance of Iowa learners in STEM fields,
2. Increased emphasis on STEM fields in Iowa from Pre-K through 20,
3. More high-quality STEM teachers prepared by Iowa's institutions of higher education,
4. An Iowa citizenry that recognizes the importance of STEM in leading productive lives and creating/sustaining a vibrant economy,
5. A national leader in STEM workforce preparation and retention in STEM careers,
6. Wide-scale partnership of Iowa's education systems and private enterprise, and
7. Coordinated, complementary and uniform STEM education opportunities across Iowa (IMSEP, 2011).

It is the objective of the Iowa STEM Education Roadmap, the Iowa Governor's STEM Advisory Council, and the Iowa STEM Equity Pipeline initiatives that Iowa students will once again rank near the top in the nation in STEM fields. The STEM Education Roadmap not only intends to produce more STEM graduates and better STEM teachers, but it also hopes to retain students in the STEM majors who graduate from Iowa's colleges and universities and employ them in careers in STEM fields within the state of Iowa.

Statement of the Problem

As policymakers are moving toward a performance-based funding model, the community college graduation rate does not support the need for increased funding. In 2007, the graduation rate for first-time, full-time students attending 2-year institutions was 30% (NCES, 2012). Although many community college students attend college with the sole intention of receiving necessary training or skill development and do not intend to complete a degree, the degree completion rate at community colleges does not speak well for the increased funding needed to continue to educate the growing population of community college students. There are many barriers that prevent community college students from completing their degrees: working part-time or full-time jobs, caring for children or family members, lack of available funding, poor academic preparation, and lack of institutional support (Espinosa, 2011; Lloyd & Eckhard, 2010; Reyes, 2011; Scott et al., 2009; Whalen & Shelley, 2010). Many of these barriers will continue to impact the students' education regardless of completion strategies implemented by the community college.

Existing studies have shown that an increase in engagement can assist students in overcoming some of the barriers that currently prevent degree completion (Astin, 1984, 1993; Deil-Amen, 2011; Kuh et al., 2010; Pascarella & Terenzini, 1991, 2005; Tinto, 1998). A plethora of research on the relationship between engagement and persistence was conducted at 4-year colleges and universities, and the studies do not lend themselves well to developing an understanding of the relationship between engagement and persistence at the community college level. An understanding of the engagement practices that have positively influenced community college educational outcomes will allow community college administrators to develop best practices that increase student persistence, completion, and graduation. For this study, special attention was given specifically to understanding how engagement practices increase students' intentions to transfer to a 4-year college or university and students' STEM aspirations.

Purpose of the Study

The purpose of this study was threefold. First, this study sought to gain understanding of the demographic characteristics and engagement practices of students attending Iowa community colleges. Second, it intended to gain understanding of the influence, if any, of engagement on students' intentions to transfer to a 4-year college or university and on students' STEM aspirations. Third, the study sought to add to the current body of literature on engagement, specifically as it pertains to community college engagement. This research also hopes to inform policy by providing relevant information on the influence of engagement at the community college level.

Research Questions

The following questions were used to guide this study:

1. What are the demographic and background characteristics of students in the STEM Study Success Literacy (SSSL) study, students who intend to transfer to a 4-year institution, and students who have STEM aspirations?
2. How are student engagement constructs measured by variables in the SSSL survey?

3. Are there statistically significant differences between students who intend to transfer and students without transfer intentions, or between students with STEM aspirations and students without STEM aspirations, based on their demographic characteristics?
4. Is there a correlation between engagement variables (peer engagement, faculty/ staff encouragement/assistance, faculty engagement on coursework, and peer engagement) among students who intend to transfer or students with STEM aspirations?
5. To what extent do student demographics and student engagement levels predict students' intention to transfer?
6. To what extent do student demographics and student engagement levels predict students' STEM aspirations?

Hypotheses

Based on the review of the literature, two null hypotheses were established regarding the influence of student engagement on students' intention to transfer to a 4-year college or university and students' STEM aspirations:

H_0^1: There is no statistically significant relationship between student engagement and intention to transfer to a 4-year college or university.

H_0^2: There is no statistically significant relationship between student engagement and students' STEM aspirations.

Theoretical Frameworks

As this study sought to understand the variables that may predict students' intentions to transfer and students' STEM aspirations, it was important to develop the theoretical framework that guided this study. Creswell (2009) defined theory as "an interrelated set of constructs (or variables) formed into propositions, or hypotheses, that specify the relationship among variables" (p. 51). This study was guided by two theories related to student engagement: the theory of involvement (Astin, 1993) and the theory of socialization (Weidman, 1989).

Much research has been conducted and continues to be done in the areas of student engagement and involvement, but Astin's (1993) theory of involvement served as the overarching framework for the study and Weidman's (1989) theory of socialization served as a secondary theoretical guide. Both Astin (1993) and Weidman focused on the influence of the independent variables associated with student background characteristics as well as the mediating variables of student engagement, campus life, and outside influences on students' educational outcomes.

Astin's Theory of Involvement

Astin's (1993) theory of involvement may be better known to some as the I–E–O (input–environment–output) theory of student engagement. The I–E–O theory was used in this study as a predictive model of student outcomes. The inputs in the model are the characteristics that individual students bring with them to college, more specifically their demographics. Possible input variables in the I–E–O model are: age, ethnicity, gender, sexual orientation, native language, intended college major, high school grade point average (GPA), and finances to pay for college. Environmental variables in the model are the experiences that shape a student's life throughout his or her education. Possible environmental variables include: amount of time spent living in a residence hall, amount of time spent working part-time or full-time, participation in extracurricular athletics, joining a club, rushing a fraternity or sorority, or developing an educational relationship with a faculty member. Institutional characteristics, such as public versus private, 2-year versus 4-year, and liberal arts versus research-intensive, also are categorized as environmental variables in Astin's (1993) theory of involvement model. The outputs outlined in the model include the students' characteristics after leaving college. Possible output variables are: degree attainment, college GPA, career goals, and religious or political views. As noted by Astin (1993), "the basic purpose of the model is to assess the impact of various environmental experiences by determining whether students grow or change differently under varying environmental conditions" (p. 7).

Astin's (1993) theory of involvement was used to frame this study because the study sought to ascertain if students' involvement in scholarly and social encounters with peers and faculty members influence students' intentions to transfer to a 4-year institution or students' STEM aspirations. This study analyzed the environmental variables of student–student and student–faculty engagement and determined if the environmental factors had any influence on the output variables, intention to transfer, and STEM aspirations.

Weidman's Theory of Socialization

Like Astin's (1993) theory of involvement, Weidman's (1989) theory of socialization suggests that students bring to college demographic characteristics that shape who they are at the time they begin their education. These characteristics may include: values, aspirations, career preferences, aptitude, and socioeconomic status. Students also encounter pressures from their parents, peers, and other influences outside of the direct educational environment (Pascarella & Terenzini, 1991, 2005; Weidman, 1989).

The characteristics that students bring with them to college are then influenced by the collegiate experiences that the students encounter throughout the course of their education. Weidman's (1989) collegiate experiences can be divided into two categories: academic and social. These categories include experiences such as the quality of institution attended, the major chosen, the institutional size, peer groups, and social and academic integration. Weidman's model analyzes the students' precollege characteristics. These characteristics include: the outside influences of peers, parents, and other influences, as well as collegiate experiences, to understand the influence that they have on students' outcomes after attending college. Some of the outcomes that Weidman included in his model consist of: career choices, lifestyle preferences, aspirations, and values.

Weidman's (1989) theory complements Astin's (1993) theory of involvement by also focusing on student background characteristics, environmental influences, and educational outcomes, while adding the additional aspect of outside influences. Weidman's theory is applicable to this study, as it sought to understand the academic and social encounters that influence students throughout the course of their education. The addition of Weidman's theory to this study helped the researcher draw correlations between students' background characteristics, academic and social engagement, and outside influences that impact their intentions to transfer and STEM aspirations

Measuring student change, the premise for this study, is relative based upon the inputs that students bring to college and the environment and the outside influences they encounter while they are at their chosen institution. Kuh et al. (2010) noted, "What students *do* in college counts more for what they learn and whether they will persist in college than who they are or even where they go to college" (p. 8). Recognizing that change happens regardless of where students attend college or even if they do not attend college, this study sought to go beyond simply determining if change exists and look deeper into the influence of the college environment in the change process. Astin (1993) noted, "The real issue is not the impact of college but the impact of college characteristics or, more precisely, the comparative impact of different collegiate experiences" (p. 7).

Significance of the Study

This study intended to provide administrators and policymakers with an understanding of Iowa community college students and the engagement practices that influence students' intentions to transfer and STEM aspirations. Through the use of exploratory and confirmatory factor analyses, this study established a model of community college student engagement and provided an understanding of how community college students engage with their peers, instructors, staff members, and advisors/counselors. The student engagement model provides administrators and policymakers with an overview of how all community college students in the state of Iowa interact at the college they attend.

Further analyses through the use of two logistic regression analyses established which demographic and engagement variables influence students' intentions to transfer or students' STEM aspirations. The analysis of the logistic regressions provides policymakers and community college administrators with best practices in engagement to pass on to their deans and instructors to implement these best practices into the school and classroom environment. The best practices also should be relayed to students to encourage their interaction in the engagement opportunities that positively influence students' transfer intentions and STEM aspirations.

Although the intent of this study was to develop the community college student engagement model, the logistic regression analyses were based on specific engagement variables rather than the construct method utilized by current engagement studies such as the National Survey of Student Engagement and the Community College Survey of Student Engagement (CCSSE). This study differed from current and previous studies on the influence of engagement on student outcomes in that the lack of constructs used in the logistic regression provide administrators and policymakers with specific examples of engagement opportunities that they can offer, encourage, and promote to help students transfer to 4-year institutions or major in STEM-related fields.

The creation of CCSSE has led to an increased amount of research on community college student engagement. However, there is still a lack of literature on community college students when compared to the research conducted using students at 4-year institutions. This study's findings add to the current body of literature on the influence of engagement on students' intention to transfer and students' STEM aspirations. Hopefully, findings of this study will encourage further research into the influence of engagement on transfer intentions and STEM aspirations for community college students across the nation.

Definitions of Terms

The following definitions were used for the purpose of this study:

Engagement: Social and academic interaction with peers and faculty members that occur as a result of attending a college.

Intention to transfer: A student's plans to continue her or his education by moving from a community college and enrolling in courses at a 4-year public or private college or university.

Persistence: The continuation of educational endeavors by maintaining enrollment in, transferring to, or graduating from a public or private postsecondary institution.

SSSL: STEM Student Success Literacy

STEM: Science, technology, engineering and math

STEM Aspirations: Students who intend to transfer to pursue a degree in a STEM-related field.

Underrepresented Minorities (URM): Ethnic minority groups that are significantly underrepresented in STEM-related fields at postsecondary institutions. Underrepresented ethnic groups in STEM fields include: Blacks, Hispanics, Native Americans, Alaskan Natives, and Native Pacific Islanders (National Science Foundation [NSF], 1991, 2011).

Summary

This study sought to determine the relationship between community college student engagement and students' intentions to transfer and students' STEM aspirations. The study was grounded in Astin's (1993) theory of involvement and Weideman's (1989) theory of socialization and intended to provide policymakers, community college administrators, instructors, and community college students with best practices to promote and encourage student transfer to 4-year institutions and STEM aspirations.

This dissertation comprises five chapters. Chapter 1 provides an introduction and overview of the study as well as an understanding of the theoretical framework that guided the study. It also includes a statement of the problem, significance of the study, research questions and definition of terms to be used throughout the study. Chapter 2 provides a review of the current literature on community colleges, STEM education, and student engagement. Chapter 3 provides the methodological and analytical design of the study. It provides an overview of the survey design, data collection processes, and data analysis methods. Chapter 4 includes a presentation of the results of the analyses laid out in the previous chapter. The dissertation concludes with a discussion of the results, implications for policy and practice, and recommendations for future research in Chapter 5.

CHAPTER 2. REVIEW OF THE LITERATURE

Introduction

In the past decade, the United States has begun to refocus funding and educational policy to improve the retention and graduation rates of STEM students. Chen (2009) noted in the NCES brief, *Students Who Study Science, Technology, Engineering, and Mathematics (STEM) in Postsecondary Education*, that approximately 14% of undergraduate students were enrolled in a STEM field. The low percentage of students enrolled in and graduating from STEM programs has led to a call for an increased focus on improving the U.S.'s global standing in STEM education.

The increased interest in STEM student retention efforts has led to the passage of several key pieces of legislation in an effort to improve retention and graduation rates of STEM students across all levels of education. Four key pieces of legislation that sought to improve the quality and availability of STEM education were passed by the 109th and 110th Congresses: The National Aeronautics and Space Administration Authorization Act of 2005, The Deficit Reduction Act of 2005, The National Defense Authorization Act of 2006, and The America COMPETES Act of 2007 (Kuenzi, 2008). The Deficit Reduction Act of 2005 and the America COMPETES Act of 2007 provided resources and funding to encourage and improve STEM education at the postsecondary level.

The Deficit Reduction Act of 2005 provided resources to increase efforts in retention and persistence of STEM students. It established the Academic Competitiveness Grants as well as the National Science and Mathematics Access to Retain Talents Grants. These grant programs provide STEM students with supplemental Pell grant funding as long as the students remain in a STEM or foreign language-related major. The Deficit Reduction Act also launched the Academic Competitiveness Council, which is responsible for assessing federally funded STEM programs and recommending improvements to federally funded STEM initiatives (Kuenzi, 2008).

Like the Deficit Reduction Act, the America COMPETES Act offers additional resources and funding to support STEM education, including STEM education at the postsecondary and community college level. In 2007, the America COMPETES Act was enacted to analyze current federal STEM programs, and it also established several new programs to encourage STEM student retention and persistence. The Department of Energy, Department of Education, and the National Science Foundation (NSF) began new programs under the America COMPETES Act. The programs established through the Department of Energy sought to improve K–12 STEM education but also focused on prospective and current STEM teacher preparation at the K–12 level. Outside of the K–12 focus, the Department of Energy established three programs that sought to encourage students to pursue majors in STEM fields. The Department of Education focused on the improvement of K–12 teaching in STEM fields and called for aligning K–12 standards with workforce needs and higher education requirements. The programs established through the NSF concentrated on postsecondary STEM education and aimed to increase retention and completion rates among STEM students in associate or baccalaureate programs. The NSF provided funding for the STEM Talent Expansion Program to increase the number of STEM students completing postsecondary degrees; the Graduate Research Fellowship Program, which provides funding for research-based master's or doctoral degrees in STEM fields; and several other programs that focus on the retention of STEM students (Kuenzi, 2008).

The renewed focus on STEM education, along with the passing of STEM legislation by the 109th and 110th Congresses and the call for an increase in STEM student graduation rates, has led to new research on the state of STEM education in the United States. With the increased focus on STEM education many researchers, including those at the Higher Education Research Institute of UCLA, the NCES, and the Iowa State University Office of Community College Research and Policy, have focused on examining STEM student completion rates, the demographics of STEM students, and the influence of community college education on STEM graduation rates. Although many studies have examined the completion and retention rates of STEM students and the types of students who eventually graduate with STEM degrees, the studies have not explored the environmental influences that impact STEM student retention and graduation. A number of studies (i.e., Astin, 1984, 1993; Kuh et al., 2010; Pascarella & Terenzini, 1991, 2005; Tinto, 1998; Weidman, 1989) have found that students who are engaged socially and academically in their college persist and graduate at higher rates than do nonengaged students. However, few of those studies focused on community college students or STEM students.

This study sought to understand the correlation, if any, between community college student engagement on the students' intentions to transfer and on students' STEM aspirations. This literature review provides the reader with an understanding of the current literature in three areas: community college education, STEM education, and engagement. The community college education section of this literature review includes a discussion of the current state of community colleges in the United States, the role of community colleges in assisting students in transferring to a 4-year college or university, the demographics of community colleges students in the United States, the demographic characteristics of students enrolled in community colleges in Iowa, the community college completion agenda, and the Iowa community college completion agenda. The second section, STEM education, provides an overview of the literature on the current state of STEM education in the United States, an overview of Iowa STEM education and initiatives to improve education within the state, and the role community colleges play in educating STEM students. The engagement portion of this literature review includes a review of the literature on student–student engagement, student–faculty engagement, and community college student engagement.

Community College Education

Since the creation of the first American community college in 1901 and the expansion of the community college system in the 1960s, the roles of community colleges have remained consistent: provide workforce/vocational training, offer transfer-quality general education courses, provide developmental education to allow for the improvement of necessary skills, and offer community service programs in the form of continuing education courses (A. M. Cohen & Brawer, 2008; Coley, 2000). The American community college serves several purposes for the students within its walls and the community in which it is located, but as tuition rates have continued to rise at public and private 4-year institutions, the community college role in the transfer process has continued to increase. In the past decade, community colleges have continued to focus on working with 4-year colleges and universities to establish articulation agreements that allow students, and their credits, to easily transfer from a community college to a 4-year institution. The increase in articulation agreements and the fact that roughly half of all students in higher education begin at a community college has increased awareness in the community college transfer process (A. M. Cohen & Brawer, 2008; Coley, 2000; Laanan, 2000, 2003).

Community College Transfer Agenda

The general education transfer process is not new to higher education or the community college system, but the role of transfer education within community colleges has continued to increase over time. Scholars have suggested that American community colleges will continue to be assessed based on the success that their students have upon transfer to 4-year institutions (A. M. Cohen & Brawer, 2008; Cosand, 1979; Thornton, 1966).

In Coley's (2000) report, *The American Community College Turns 100*, he reported that nearly half of all current community college students intended to transfer to a 4-year institution whereas 37% planned to further their education after completing a bachelor's degree. Three years later, Laanan (2003) indicated that nearly one in four community college students intended to attain a bachelor's degree, 25.3% planned to complete a master's degree, and 10.7% intended to attain a doctorate degree. Community college students, like those attending 4-year institutions, aspire to complete advanced degrees that will positively impact their lives. Nearly one in four community college students transfer to a 4-year college or university, but 39% of those students who indicate that they plan to transfer actually do so within 5 years of enrolling at the community college. Students who indicated that they plan to attain an advanced degree transfer at a higher level than do students who plan to complete a baccalaureate degree as their highest degree (Coley, 2000).

Laanan (2003) studied community college transfer students over a 5-year period, from 1989 to 1994. The study found that 25% of students completed a bachelor's degree within the 5-year timeframe and an additional 44% were still enrolled at 4-year institutions. The overall persistence rate of 69% in that study parallels the findings of Lee, Mackie-Lewis, and Marks (1993), who found that community college transfer students persist toward completion of a baccalaureate degree at the same rate as do students who enter 4-year institutions immediately upon graduation from high school.

As community colleges and 4-year institutions continue to work together to develop articulation agreements, especially in STEM fields, the percentage of community college students transferring to and completing degrees at 4-year institutions will continue to increase. The continued increase in tuition at 4-year colleges and universities along with the high quality affordable education offered at American community colleges will continue to cause an increase in the number of students attending community colleges with the sole intention of transferring to a 4-year institution. The role of the community college in higher education continues to adapt to meet societal needs but stays grounded in the ideals that have allowed them to assist in educating the workforce and assisting students in transferring to 4-year institutions.

Demographics of Community College Students

According to the American Association of Community Colleges' (AACC's) *2012 Community College Fast Facts* (AACC, 2012a), there are 986 public, 115 independent, and 31 tribal community colleges for a total of 1,132 community colleges in the United States. Those 1,132 community colleges conferred more than one million degrees and certificates (425,000 certificates and 630,000 degrees) in 2009. Of the students attending community colleges in the United States, the mean age is 28 years. Nearly 40% of community college students are under 21 years of age, 45% are between 22 and 39 years of age, and 15% are older than 40. Female students make up more than half (57%) of all community college students. Although Hispanic and African American students together comprise nearly one third (16% and 14%, respectively) of all community college students, the majority (54%) of students are Caucasian. A much smaller percentage of students identify as Asian/Pacific Islander (6%), Native American (1%), and other/unknown (10%). The majority (58%) of students attend part time; 42% attend the community college on a full-time basis.

Community college students rely heavily on outside funding, and many are forced to work part or full time to fund their education. Of the students enrolled full-time, 21% are employed full time and 59% are employed on a part-time basis. Nearly 90% of all part-time students are employed either part time (47%) or full time (40%) while also taking their community college courses. Nearly half (46%) of all community college students received some sort of financial assistance in 2008. Of the students receiving some financial assistance, 21% received federal grants, 10% utilized federal loans, 13% received state aid, and 11% were given institutional aid (AACC, 2012a).

Iowa community colleges and student demographics. The state of Iowa is home to 15 community college districts that serve 16 individual community colleges. Each community college district serves one region of the 99 Iowa counties. The community college districts originally were established around the transportation, cultural, and business hubs within the state. The community college districts include: Northeast Iowa Community College (CC), North Iowa Area CC, Iowa Lakes CC, Northwest Iowa CC, Iowa Central CC, Iowa Valley CC District (Ellsworth CC and Marshalltown CC), Hawkeye CC, Eastern Iowa CC District (Clinton CC, Muscatine CC, and Scott CC), Kirkwood C, Des Moines Area CC, Western Iowa Tech CC, Iowa Western CC, Southwestern CC, Indian Hills CC, and Southeastern CC.

The *Annual Condition of Iowa's Community Colleges 2011* (Iowa Department of Education, 2011) report provides a profile of the Iowa community college student during the

2011–12 academic year. When the academic year began in Fall 2011, 105,975 students were enrolled in the 15 Iowa community college districts. The Fall 2011 enrollment was down 0.59% statewide, a decline that can be attributed to the recent economic recovery that saw a large number of displaced workers, who had previously enrolled at community colleges, returning to work. The decline in fall enrollment also is attributable to the continuing decline in the statewide population of high school students. Of the nearly 106,000 students who enrolled in Iowa community colleges in Fall 2011, more than half (51.8%) were enrolled on a part-time basis.

Students enrolled in Iowa's community colleges enroll in one of three academic tracks. The majority of students enroll in Associate of Arts or Associate of Applied Science programs (64.1%), which also are known as college parallel programs and prepare students to transfer to a 4-year college or university. The next largest cohort of community college students (30.7%) enroll in career and technical education programs that prepare students to directly enter the workforce upon completion of a degree, certificate, or diploma. A small percentage (4.9%) of Iowa community college students enroll in career options programs that allow them to transfer to a 4-year institution or pursue a career in their chosen field upon completion of the program (Iowa Department of Education, 2011).

Students attending Iowa community colleges have a unique demographic makeup that is not generalizable to community colleges nationwide but compares favorably to rural midwestern community colleges of similar sizes. The majority of Iowa community college students are female (55%) and between the ages of 19 and 25 (72%). The average age of Iowa community college students is 23 years. An overwhelming majority (92%) of students attending Iowa community colleges are residents of the state of Iowa. Of the Iowa community college students who reported their ethnicity during the 2011–12 academic year, 86% were Caucasian, 7% were African American, 5% were Hispanic, 2% were Asian/Pacific Islander, and 1% were of two or more races (Iowa Department of Education, 2011). The demographic makeup of students enrolled in Iowa community colleges today is not the same as those who attended when the community college districts were established in the 1960s, so as the demographics and needs of community college students continue to change the community college must also adapt to meet those needs. The demographics reported in the *Annual Condition of Iowa's Community Colleges 2011* (Iowa Department of Education, 2011) may resemble those reported in this study but will undoubtedly evolve to represent a new Iowa community college student.

Community College Completion Agenda

The open door policy, accepting all students regardless of ability level, in the community college system could be seen as a double-edged sword for policymakers and administrators. Since the inception of the American community colleges in the 1960s, they have provided open access, high-quality education at an affordable price close to their students' homes (AACC, 2012b; Phillippe & Patton, 2000). The community colleges' open door policy makes it possible for full-time or part-time students to begin and end programs and courses at any time they choose, a condition that is known in the community college sector as "stopping in" and "stopping out." The fact that students enroll in community colleges to seek training but do not intend to complete a degree is often difficult for policymakers to grasp. This stop-in and stop-out mentality that exists at the community college level wreaks havoc on retention and completion rates and has led national and state educational associations to call for an increase in community college graduation rates (Complete College America, n.d.; Marcus, 2011).

As community college enrollments continue to rise, their graduation numbers are not following suit. According to the AACC's (2012c) report *Reclaiming the American Dream: Community Colleges and the Nation's Future*, 13 million full- and part-time students were enrolled in community colleges in 2009. Of those 13 million community college students, 42% were first-generation college students, 15% were returning to community colleges seeking education needed for a career change, and more than 50% were non-traditional students (Koebler, 2012). During the 2008–09 academic year, 630,000 associate's degrees and 425,000 certificates were awarded at community colleges across the nation. Although these numbers appear to be outstanding, only 46% of community college students attained their goals of completing the degrees, certificates, or training that they desired upon initial enrollment (AACC, 2012c).

There are numerous obstacles that stand in the way of students completing their coursework and attaining community college degrees. Students attending community colleges are more likely to be place-bound than are students attending public or private 4-year colleges and universities. Community college students often have children or family members that they care for while also attending class. In 2009, 13% of all community college students were single parents (AACC, 2012b). These students' outside responsibilities leave them with less time to devote to studying, seeking guidance on coursework, or engaging with their peers or faculty members.

A lack of financial support also leads to the low completion and graduation rates for community college students. Many of these students are from lower socioeconomic households that cannot afford to assist the student in paying for his or her education, or they are non-traditional students who are returning to college to complete a degree or receive additional training. These students often lack the funding to complete the degrees that initially drew them to the community college, and this has a negative impact on the community college completion and graduation rates. Students who struggle financially to pay for their education often are forced to work part-time or full-time throughout the course of their academic career. More than 45% of community college students receive some form of financial assistance, 80% of all full-time students are employed on a full-time or part-time basis, and 87% of part-time students are employed on a full- or part-time basis (AACC, 2012b). The need to work on a full- or part-time basis while still attending college takes away from time that the students could spend studying, engaging in the college environment, or receiving extra assistance.

One of the most highly noted issues that impedes community college student completion and graduation rates is that many community college students are ill-prepared to complete the coursework necessary to attain their educational goals. Due to the open-door policy, many community college students enroll without having a high school diploma or a GED. These students often require extensive remedial education before completing the initial college coursework. The need for remedial education often delays the students' graduation timelines and forces them to spend more time at the community college. This, in turn, forces the students to pay more for their education and spend more time away from their families and may require some students to work longer hours (*Achieving the Dream*, n.d.; Complete College America, n.d.; Espinosa, 2011; Lloyd & Eckhardt, 2010; Marcus, 2011; Reyes, 2011; Scott et al., 2009).

The life of community college students is not easy. They deal with far more obstacles than do most 4-year college students. However, they are expected to persist and graduate at similar rates to their 4-year counterparts. Fortunately, in recent years a great deal of research and funding has been focused toward increasing community college student persistence, and this research and funding hopefully will increase community college completion and graduation rates in the upcoming years.

A renewed focus on STEM education has led to the recent development of initiatives and strategies to improve graduation and retention rates at community colleges across the nation. One of the most notable initiatives to increase community college graduation rates is Achieving the Dream. The goal of Achieving the Dream is "success for more of the nation's 6.7 million community college students, especially students of color and low-income students" (*Achieving the Dream*, n.d., "Goals"). One of the definitions of success used in the Achieving the Dream initiative is increasing community college completion and graduation rates. Achieving the Dream provides community college administrators and policymakers with data to inform decisions on how to increase completion and graduation rates. The Center for Community College Student Engagement (CCCSE) at the University of Texas at Austin also is providing community colleges with research and strategies to improve community college completion and graduation rates. CCCSE has developed a consortium of community colleges that will assist in studying current community college students, their graduation and completion rates, and the factors that influence those rates (Center for Community College Student Engagement [CCCSE], 2012; Marcus, 2011). The AACC also has established the 21st Century Initiative, which calls for community colleges to educate an additional five million students by 2020. The 21st Century Initiative, supported by the Bill and Melinda Gates Foundation, Kresge Foundation, ACT, and Educational Testing Service, calls for reforming the current community college system to provide pathways to student success (AACC, 2012c).

Iowa community college completion agenda. The Iowa Community College President's Council has followed the lead established by the Lumina Foundation's Achieving the Dream, the Gates Foundation's Complete College America, and the National Governors Association's Complete to Compete initiatives to establish the Iowa Community College Completion Initiative in 2012. The goal of the Iowa Community College Completion Initiative is "to increase the number of higher education credentials earned by Iowa community college students" (Iowa Association of Community College Trustees [IACCT], 2012). Iowa community colleges plan to meet this goal through a series of 11 commitments including initiatives such as: making certificate and degree completion the top priority at the community college, adapting and improving college policies and procedures to improve students' opportunities to complete higher education credentials, ensuring the completion initiatives are incorporated into the strategic planning processes, and learning from colleges both within the state of Iowa and across the nation to develop best practices to improve the attainment of higher education credentials (IACCT, 2012).

The Iowa Community College Completion Initiative will be measured based on a series of metrics previously established by the National Governors Association's Complete to Compete initiative. The Iowa community colleges will be measured and will report annually on both outcome and progress metrics. The outcome metrics used to measure the success of the Iowa Community College Completion Initiative include: an assessment of the number of degrees and certificates awarded, an analysis of the number of students and the overall percentage of students who graduated or completed a certificate in the normal or extended time, the number and percentage of students who transfer from one of the 15 Iowa community college districts to 4-year institutions, and the average amount of time and the average number of credits that students needed to complete a degree or certificate (IACCT, 2012). Progress metrics that will analyze the effectiveness of the Iowa Community College Completion Initiative include: enrollment and subsequent success in remedial and developmental education courses, student success in first-year courses, accumulation of credits and persistence, and completion rates (IACCT, 2012).

A review of the *Annual Condition of Iowa's Community Colleges 2011* (Iowa Department of Education, 2011) revealed the completion, graduation, and transfer rates of Iowa community college students for the 2011–12 academic year and fiscal year 2011. During the 2011–12 academic year, the 15 Iowa community college districts awarded 17,924 degrees, certificates, and diplomas, an increase of 13% from 2010–11. Of the nearly 18,000 credentials awarded, 29.3% were Associate of Arts degrees, 28.4% were Associate of Applied Science degrees, 7.9% were Associate of Science degrees, 13.1% were diplomas, and 12.2% were certificates. The report also revealed the results from a longitudinal study that followed first-time, full-time students from fiscal year 2007 to 2010. The study reported findings on 10,725 students and revealed that 53.4% of the students were deemed successful, graduating from the community college or transferring to a 4-year institution. More than one in three students (35.8%) graduated with a degree, diploma, or certificate while attending the community college (Iowa Department of Education, 2011).

A study of students graduating from or leaving Iowa's community colleges in 2002 revealed transfer rates for students who completed an Associate of Arts degree or Associate of Applied Science degree or who did not complete a degree within three years of enrolling in the community college. More than two-thirds (67.l%) of students who completed an Associate of Arts degree transferred to a 4-year college or university; 15% of those students who completed an Associate of Applied Science degree transferred; and 15.6% of community college students who did not complete a degree, diploma, or certificate transferred to a 4-year institution. Of the Iowa community college students who transferred to one of the three Iowa regents universities, nearly 60% graduated within 4 years of transfer. Students transferring to Iowa State University and the University of Iowa had a 4-year graduation rate of 58%, and the University of Northern Iowa community college transfer graduation rate was slightly higher at 61% (Iowa Department of Education, 2011).

The Iowa community colleges continue to improve upon their completion and retention rates and, with the implementation of completion measures such as the Iowa Community College Completion Initiative, students attending community colleges will have increased opportunities to complete higher education credentials and, when desired, transfer to a 4-year institution to pursue a higher degree. The goal, commitments, and metrics established in the Iowa Community College Completion Initiative will assist the 15 Iowa community college districts in improving the number of higher education credentials awarded in upcoming years (Iowa Department of Education, 2011).

STEM Education

The United States was once viewed as a world power on the cutting edge in STEM fields. Unfortunately, that is a far outdated view of the American educational system. The United States is no longer a world leader in educating students in STEM fields and has begun to lag in the number of students who complete degrees in STEM fields. Thousands of students every year enroll in college as a STEM major only to later change majors or completely drop out of college. To regain its previous world class status in STEM fields, the United States must attract more students into STEM-related majors, retain those students who begin STEM programs, and assist them in persisting through to graduation.

According to data published in a Higher Education Research Institute of UCLA research brief (Hurtado, Chang, Eagan, & Gasiewski, 2010), approximately 31% of current undergraduate students intended to major in a STEM field. This is the same percentage of students who planned to major in STEM in 1971. In 1971, Caucasian/White and Asian students made up 38.4% of STEM students, whereas URM students made up only 27.9% of STEM students. Those numbers have equalized in the last 40 years with Caucasian/White and Asian students accounting for 34.3% of all STEM students and URM students accounting for 34.1% (Hurtado et al., 2010). Kuenzi (2008) noted that fewer than one in four of the 2.5 million degrees awarded to students in the United States during the 2002–03 academic year were awarded to majors in STEM-related fields. The United States continues to lag behind other nations in the number of students graduating with degrees in STEM fields. The country ranks second to last in the percentage of STEM degrees awarded when compared to countries that award more than 200,000 degrees annually and ranks 20th in the percentage of 24-year-olds with degrees in natural science or engineering.

The lack of an increase of students in STEM majors is troubling due to the lack of qualified individuals available to fill open positions in STEM fields. However, it's not nearly as troubling as the attrition rate for students who intend to major in a STEM field. Huang, Taddese, and Walter (2000) explored STEM student completion rates and found that only 46% of Caucasian/White and Asian students who initially enrolled in STEM fields completed a STEM degree within 5 years. URM students fared considerably worse, as only 26.8% completed a STEM degree within 5 years. The study also examined the percentage of students still enrolled in STEM fields and the percentage of students who had dropped out and found that 15.4% of Caucasian/White and Asian and 20.7% of URM students were still enrolled in a STEM program and 22% of both groups had completely dropped out of college (Huang et al., 2000).

Understanding that STEM students complete degrees at a lower rate than do non-STEM majors leads to an examination of the characteristics of successful and unsuccessful STEM students. Whalen and Shelley (2010) conducted a study on the 6-year retention/ graduation rates of students in STEM and non-STEM majors and found specific characteristics to be predictors of success. The study utilized several factors to predict long-term retention/graduation rates, including: GPA; financial assistance in terms of work–study, student loans, and scholarships; gender; ethnicity; amount of time spent living in a campus residence hall; high-school rank upon graduation; ACT score; out-of-state residence status; and STEM or non-STEM major. The study noted that women and minorities continue to be underrepresented in STEM fields and that female and URM students who enter into STEM fields often experience a "chilly climate" and lack confidence, require more financial assistance, and eventually drop out at higher rates than do their peers. Whalen and Shelley's findings were similar to other studies on the characteristics of successful STEM students. The study found that women and URM students in STEM fields persisted at statistically significantly lower rates than did their peers and that all students who began as STEM majors retained/graduated at statistically significantly lower rates than did students who began as non-STEM majors.

Chen's (2009) brief discussed the characteristics of successful STEM students. The brief described that students who entered a STEM field at the age of 19 completed their intended degree at a higher rate than did students who initially enrolled in the STEM field at an older age. Asian/Pacific Islander and Caucasian students also completed baccalaureate STEM programs at higher rates than did their Hispanic or African American peers. The brief also noted that dependent students completed STEM programs more frequently than did independent students who may have had responsibilities outside of the classroom. Students whose parents had completed at least a 4-year college degree were more likely to complete their STEM degree program than were students whose parents completed less formal education. Students who were more academically prepared to attend college and who had completed a more rigorous high school curriculum completed STEM degrees at higher rates than did their counterparts (Chen, 2009). A clear understanding of the characteristics of students who currently persist at high rates in STEM fields is beneficial in developing and implementing measures to assist other students who are currently struggling to complete STEM degrees.

The attrition rate of STEM students needs to be addressed and measures need to be put into place to retain those students and assist them in persisting through to graduation. Suggested initiatives to increase STEM students' retention, persistence, and graduation include: STEM focused learning communities; peer-led team learning; increased tutoring; residential housing environments for STEM students; shorter, more intensive immersion courses; STEM-specific advising; instructors focused more on teaching and less on research; involving students in current research studies; and increasing the number of minority instructors in STEM fields (CCCSE, 2012; Espinosa, 2011; Hoffman, Richmond, Morrow, &

Salomone, 2002; Hurtado et al., 2010; Kendricks & Arment, 2011; Kuenzi, 2008; Lloyd & Eckhardt, 2010; Palmer, Davis, & Thompson, 2010; Reyes, 2011; Scott et al., 2009; Shushok & Sriram, 2010; Whalen & Shelley, 2010). The community college plays an important role in training STEM students as well as in preparing STEM students to transfer to a 4-year college or university and complete a bachelor's, master's, or doctoral degree.

Iowa STEM Education

Less than two decades ago, Iowa was a national leader in STEM education (Clayworth, 2012; Duncan, 2011; *Iowa Governor's STEM Advisory Council*, 2011). In 1992 Iowa ranked first in the nation on the National Assessment of Educational Progress; by 2009 the state had fallen to 16th (Duncan, 2011). Unfortunately, Iowa has fallen from its perch as a national leader to a state where half of all students are not prepared to take college level math and more than one in three (37%) students are not prepared to take college level science courses (IMSEP, 2011). In a study of the proportion of undergraduate degrees and credentials awarded to students in STEM-related fields (excluding health), the state of Iowa lags behind the national rate (10.9% compared to 12.3%; IMSEP, 2009).

A study focusing on underrepresented students in STEM education concentrated on the completion rate of females and minorities in STEM majors over a 9-year period. Between 1999 and 2008, the number of degrees awarded to females in STEM increased by 16%, from 1,724 in 1999–2000 to 2,057 in 2007–08. Undergraduate STEM degrees awarded to females increased by 3%, graduate STEM degrees awarded to women increased from 39% in 1999–2000 to 46% in 2007–08, and professional STEM degrees awarded to females also increased by 7%. Unfortunately, the study did not find similar increases in the number of STEM degrees awarded to minority students. The number of STEM undergraduate degrees awarded to minority students increased by 1%, STEM graduate degrees awarded to minorities held steady at 6%, and professional STEM degrees awarded to minority students decreased from 11% to 9% (IMSEP, 2009).

During the 2009–10 academic year, the 15 Iowa community college districts awarded 4,843 certificates and 10,932 degrees. Of the certificates and degrees awarded by Iowa community colleges in 2009–10, some 365 certificates (7.5%) and 997 degrees (9.1%) were awarded to students in STEM fields (Horn & Pollock, 2012).

In response to the current STEM situation in the state of Iowa, Governor Terry Branstad established the Iowa Governor's STEM Advisory Council with the signing of Executive Order 74 in July 2011. The creation of the STEM Advisory Council aimed to increase focus on STEM education with hopes to produce higher achievement in STEM education and expand career opportunities in STEM-related fields (Branstad, 2011). The Iowa Governor's STEM Advisory Council established eight targeted priorities to assist in meeting the goals of an increased focus on STEM, higher STEM achievement scores and increased career opportunities set forth in Executive Order 74. The outlined eight targeted priorities were:

1. *Student interest and achievement*, which called for the development of the Iowa STEM Network. The network would consist of six geographical regions that would provide STEM education and advancement opportunities to be offered within the region. The six regions would work together to share information and resources in hopes of producing best-practices models of STEM education to be used across the state.

2. *Technology enhanced instruction for global learning*, which intended to provide lifetime learning opportunities to all Iowa citizens through the use of technology.
3. *STEM teacher recruitment and preparation*, which called for increased STEM teacher preparation and continuing education courses including real-world experiences that would help recruit and retain talented STEM educators.
4. *STEM learner readiness for postsecondary education and career*, which hoped to prepare students for success in challenging academic disciplines, thus preparing them for high-skill and high-wage careers in STEM-related fields. Key resources and assessment strategies that have been successful in promoting academic rigor in STEM education would be identified. Providing real-life experiences would also be a key to successfully educating Iowa STEM students for postsecondary education and eventual careers in STEM fields.
5. *STEM education policy*, which called for the development of an action plan to return STEM education in the state to a nationally and internationally competitive level. Recommendations for the action plan included a refocus of education toward competency-based learning, equality of STEM education across the state, encouraging partnerships between the K–12 school system and local business and industry, preparing and retaining highly-qualified STEM educators, and encouraging underrepresented minorities in STEM fields to pursue STEM degrees and careers.
6. *Public awareness of the importance of STEM education for the economy and society*, which intended to educate all Iowans on the importance of STEM

education and vocations within the state, as well as the challenges that students in STEM-related fields encounter during their education and job search process.

7. *Public/private partnerships and mapping STEM education to economic development,* which called for increased partnerships and collaborations among K–12 school districts, higher education, business and industry, and nonprofit organizations to provide and promote opportunities for economic growth in the state of Iowa in STEM-related fields.
8. *STEM for all—the highly-abled, underrepresented and nontraditional,* which sought to increase the number of high-ability, underrepresented, and nontraditional students in STEM fields and in STEM careers within the state through the development of a 5-year plan to increase recruitment and retention (*Iowa Governor's STEM Advisory Council*, 2011).

The Governor's STEM Advisory Council also established six STEM hubs and 59 representative communities in which to carry out their eight targeted priorities and promote STEM education across the state (*Iowa Governor's STEM Advisory Council*, 2011).

In addition to the Iowa Governor's STEM Advisory Council, the Iowa STEM Equity Pipeline and the Iowa STEM Education Roadmap established goals to promote STEM education and increase the number of STEM degrees awarded to students in the state of Iowa. The Iowa STEM Equity Pipeline is focused on promoting STEM education to females and minority students, whereas the Iowa STEM Education Roadmap is focused on preparing students for further education and careers in STEM-related fields (IMSEP, 2009, 2011). The passage of recent legislative action and an increased awareness of the need for the improvement of STEM education has led the state of Iowa to begin to refocus its attention and resources toward improving STEM education.

Role of Community Colleges in STEM Education

As the price of a college education has steadily increased, the number of students beginning their educational careers at community colleges has continued to rise. More students than ever before are choosing to complete at least some of their general education courses at a community college close to their home that offers a high-quality education at a more affordable price than do larger public or private colleges and universities. This increase in community college attendance has become increasingly evident with STEM students as well. Programs have been put into place and funding has been delegated to increase the number of community college students transferring to 4-year colleges or universities to pursue majors in STEM fields. Community colleges continue to play a role in opening the access of STEM degrees for students attending community colleges, especially female and URM students (Berger & Malaney, 2003; NSF, 2001; Starobin & Laanan, 2008).

STEM students attending community colleges are, at times, unique from other community college students. They may take all of their general education courses and complete an associate's degree, complete a couple of courses during the summer, or retake a course in a more intimate educational setting. Regardless of how or why they attend community colleges, STEM students are making up a larger proportion of the community college student body (Reyes, 2011).

Recent studies revealed that nearly half of all STEM graduates, as well as half of all bachelor's and master's graduates in science, engineering and health fields, have completed at least one class at a community college (Mooney & Foley, 2011; Reyes, 2011).

Community colleges also serve as pathways for females and URMs in STEM fields (Brazziel & Brazziel, 1994; Laanan, 2001; Starobin & Laanan, 2008). Tsapogas (2004) noted that 4-year students majoring in STEM-related fields who have attended community colleges are more likely to be female and nontraditional age; have a marital status of divorced, widowed, or separated; and identify as Hispanic, American Indian/Alaskan Native, or African American. As more students with STEM aspirations choose to begin their education at community colleges, the community colleges must provide more resources to assist students in attaining their STEM goals and completing the course or program that they have enrolled in at the community college.

Engagement

Research on the influence of student engagement on educational outcomes dates back to the early works of Alexander Astin (1984), Vincent Tinto (1975), and Ernest Pascarella and Patrick Terenzini (1976). The research on student engagement continues to develop through data collected at the CCCSE and the National Center for Student Engagement. This section of the literature review focuses on two main types of student engagement found in the majority of the current literature: student–student engagement and student–faculty engagement. Student–student engagement focuses on the interactions and relationships that students have and develop during their time attending the college, whereas student–faculty engagement concentrates on the relationships and interactions students have with instructors, faculty members, and college personnel. This section also focuses on the current literature surrounding community college student engagement and the research that is being conducted using results from the Community College Survey of Student Engagement.

Student–Student Engagement

Throughout the course of students' educational careers there are many engagement opportunities that can have positive or negative influences on their lives. Although there are engagement opportunities that may have a negative influence on students' graduation and completion rates, there are many more factors that have shown to have a positive influence on degree attainment. In *What Matters in College: Four Critical Years Revisited*, Astin (1993) studied 21 measurements of peer involvement and the influence they had on different factors of the students' lives, including degree attainment. Some of the factors on which Astin (1993) concentrated were: number of hours spent socializing with friends, number of hours spent partying, student–student tutoring, working on group projects, participating in intramural sports, joining a fraternity/sorority, being elected to a student office, and many others.

A sense of belonging in the college community is a key factor in student satisfaction and, therefore, can be related to student success and degree attainment. Interactions with other students have positive influences on self-esteem. An increased level of self-esteem then has a positive effect on degree attainment. Astin (1993) found that student–student interaction influences not only degree attainment and graduation, but also scholarship, social activism, leadership, status striving, drive to achieve, writing ability, and emotional health (Astin, 1993, pp. 137–139). These factors all have a positive influence on student self-esteem and, therefore, on student persistence and degree attainment. Astin (1993) specifically studied the influence of student–student engagement on retention and found that living in an on-campus residence hall has a positive influence on student retention as students are more apt to engage in activities—including peer study groups, tutoring, and class discussions—with other students in their residence halls. Living in a residence hall also helps students to feel more connected to the college and provides opportunities for them to make genuine connections with other students. These connections help students form positive feelings toward the college and aid in student retention (Astin, 1993; CCCSE, 2012; Espinosa, 2011; Hoffman et al., 2002; Kendricks & Arment, 2011; Reyes, 2011; Shushok & Sriram, 2010; Tinto, 1998). Astin's (1993) study noted that "practically all the involvement variables showing positive associations with retention suggest high involvement with faculty, with fellow students, or with academic work" (p. 196).

Astin (1993) concluded that a student community is one of the keys to enhancing student success in college. Students form bonds with each other and assist fellow students in personal growth, development of leadership skills, and attainment of individual goals. Astin (1993) found that the lack of a student community created a direct negative impact on bachelor's degree attainment and academic development. In *Student Success in College,* Kuh et al. (2010) also found that the colleges selected for the DEEP (Documenting Effective Educational Practices) study all paid great attention to student–student interaction. Many of the colleges made specific room for peer study groups, required peer teaching, and employed peer tutors to increase their retention rates and qualify as DEEP colleges. Colleges such as Wofford College, University of Michigan and University of Texas-El Paso encourage student–student engagement in the form of study groups and peer tutoring in specific areas of the college, and they have formed student-staffed writing labs, support services, and tutoring and learning centers. Student–student engagement, especially associated with classroom material and activities, has a positive influence on the graduation and completion rates of many students who participate in study groups, attend learning centers, participate in intramural sports, and live in residence halls.

Student–Faculty Engagement

Many would argue that the primary function of a faculty member is to prepare the students for success in each class and eventual success in their field of choice. In the competitive and hectic times that we live in today, faculty members also must serve on numerous committees, fill administrative roles, conduct research, publish articles, and find time to enlighten and guide the youth of today. Although all of these job requirements for faculty are extremely important, the influence that they have on students' future goals, degree attainment, and persistence is often life changing.

Student–faculty interaction has such a profound influence on student success that many colleges and universities have insisted on intentional interaction between students and faculty members, both during class hours and also outside of the regular work day. Kuh et al. (2010) noted that many of the DEEP colleges make it a point to encourage, if not require, student–faculty interaction. Many of the DEEP colleges require their instructors to have an "open door policy" and actually leave their doors open while they are in the office. Many of the DEEP colleges also encourage undergraduate participation on faculty research projects, incorporating faculty members into peer study groups by providing areas for those groups to meet near faculty offices and calling for prompt and extensive feedback by both the faculty member and the student (Kuh et al., 2010).

Fayetteville State University has taken a specific interest in encouraging student–faculty engagement, and it is paying off. The retention rate for freshmen at Fayetteville State University is 77%, an impressive statistic considering the retention rate at its peer institutions is only 65%. Fayetteville State University is focusing on educating and improving the whole student. It has begun to focus on improving not only academics, but also improving the students psychologically, socially and culturally. In 1995, it embarked on the process of incorporating several new campus-wide initiatives (i.e., required service projects both on and off campus, a hands-on student government association, and an early alert system) to encourage student–faculty engagement and raise retention rates, and the entire college developed a "no-fail attitude" (Kuh et al., 2010, p. 137).

Astin (1993) took an in-depth look at the role of student–faculty engagement on degree attainment. He found that "student–faculty interaction has significant positive correlations with every academic attainment outcome: college GPA, degree attainment, graduating with honors, and enrollment in graduate or professional school" (Astin, 1993, p. 383). Student–faculty engagement also has a positive correlation with raising students' aspirations. The student–faculty engagement factors that positively influence students' STEM aspirations were found to be "hours per week spent talking with faculty outside of class, working on professors' research projects, and having class papers critiqued by instructors" (Astin, 1993, p. 267).

Student–faculty engagement not only has a positive influence on academic attainment, it also has a positive influence on personal growth in areas such as scholarship, social activism, leadership, status striving, drive to achieve, writing ability, and emotional health (Astin, 1993, pp. 137–139). Student–faculty engagement also has a positive influence on skill development in the areas of critical thinking ability, analytical and problem-solving skills, writing skills, foreign language skills, leadership abilities, preparation for graduate or professional school, and job-related skills (Astin, 1993, pp. 236–240).

The positive influence of student–faculty engagement on academic attainment, personal growth, and skill development shows the direct impact that student–faculty relationships have on the growth and development of the student as a whole. The positive impact a faculty member can have on the life of a student demonstrates the need for faculty members to continue to make teaching their number one priority and that research, publishing, committees, and administrative duties should all fall in line behind educating the students of today (Astin, 1993; Kuh et al., 2010; Pascarella & Terenzini, 1991, 2005; Tinto, 1998).

Community College Student Engagement

Although much research has been conducted on the role of student engagement in the 4-year setting, few studies have focused on engagement at the community college level. In their book *How College Affects Students*, Pascarella and Terenzini (1991) noted that only 5% of the 2,600 studies on student engagement focused on community college students. The utter lack of studies on community college engagement was further noted by Townsend, Donaldson, and Wilson (2004) when they noted that a review of more than 2,300 articles published in five major higher education journals between 1990 and 2003 revealed that less than 8% of those articles pertained to community college students. Of the research studies considered to be the backbone of the student engagement concept, very few studies took into account the uniqueness of the community college environment and the students community colleges serve.

In fact, prior to the creation of the CCCSE and the administration of the initial CCSSE in 2001, very little attention was placed on engagement in the community college setting and how that engagement may differ from that at the 4-year institutions (Marti, 2009).

CCSSE was created with the intention of providing information on effective educational practices utilized at community colleges. The CCSSE survey focuses on five key areas of engagement: active and collaborative learning, student effort, academic challenge, student–faculty interaction, and support for learners (McClenney, 2006). The engagement measures are evaluated in terms of their correlation with student outcome measures including: academic success, early academic measures, persistence measures, completion measures, and longevity measures. Factors that influence the outcome measures include the number of terms enrolled in courses, number of credits completed, GPA, success in gate-keeper courses, first-to-second-term persistence, first-to-second-year persistence, transfer-ready status, and degree or certificate completion (McClenney et al., 2007). In the past decade, CCSSE results have shown that an increase in student engagement at the community college level positively correlates with student learning outcomes.

Results of note from the CCSSE study indicate that more than 60% of all community college students enroll on a part-time basis. The results also indicate that students who work part time are significantly less likely to engage with their peers on coursework, communicate with instructors about grades or assignments, or seek input from faculty or staff members about their educational and career aspirations (CCSSE, 2005). CCSSE results also indicate that students attending community colleges are more likely to engage with their peers on coursework inside the classroom rather than making special time to work on coursework after class. Although community colleges are striving to create more engagement opportunities for their students, the 2004 CCSSE survey revealed that 84% of students indicated that they do not participate in college activities (CCSSE, 2004). The large percentage of students enrolled on a part-time basis and the outside influences that impact community college students speak to the lack of engagement in on-campus activities as well as the need to work on projects during class.

Further CCSSE results correlating engagement factors with student outcome measures revealed that four of the five engagement factors positively correlated with the student outcome measures. The engagement factor, Active and Collaborative Learning, positively correlated with student success, higher GPAs, credit hour completion, number of terms enrolled, degree persistence, and first-to-second-year persistence. First-to-second term and first-to-second year persistence as well as GPA, number of terms enrolled, and degree or certificate completion positively correlated with Student–Faculty Engagement. Academic Challenge correlated positively with academic outcomes, including number of terms enrolled, number of credit hours completed, GPA, and degree or certificate completion. The persistence outcomes, including number of terms enrolled, credit hours completed, first-to-second-term persistence, and first-to-second-year persistence, correlated positively with the Support for Learners engagement factor (McClenney, 2007; McClenney et al., 2007).

Recently, researchers Starobin, Laanan, and Jackson have focused on the role of engagement in the retention and transfer process for community college STEM students, especially concentrating on female and URM students. Their studies reaffirmed the importance of engagement, both student–student and student–faculty interaction, in the learning process and the need for community colleges to encourage and promote academic and social engagement. Female students who transferred to a 4-year institution and majored in a STEM-related field noted the importance of advising in their educational choices (Jackson & Laanan, 2011; Starobin & Laanan, 2008). Jackson and Laanan (2011) noted that more than 75% of female students in their study who transferred to a 4-year institution indicated that they met with their counselors or advisors about their intention to transfer. The development of early relationships with peers, instructors, advisors, and college staff members assists students by providing a support system and mentors who can aid them in realizing their educational goals to complete a degree or certificate or transfer to a 4-year institution (Creamer & Laughlin, 2005; McClenney & Peterson, 2006; Starobin & Laanan, 2008; Townsend & Wilson, 2006).

Summary

An abundance of research exists on the topic of student retention and graduation, and many articles have suggested strategies to increase retention and graduation rates. A number of studies also have focused on the influence of engagement on student success, but very little research has focused on the community college student. The majority of recent research on student engagement, and especially that research on community college student engagement, has focused on a construct-based model rather than on specific engagement items that influence students' transfer intentions and STEM aspirations. A lack of research on the influence of engagement on community college students' intentions to transfer and STEM aspirations as well as the lack of data on specific item-based engagement practices calls for further research on this topic.

CHAPTER 3. METHODOLOGY

Introduction

This study examined the influence that engagement has on student intention to transfer to a 4-year institution and on students' STEM aspirations. The purpose of this study was threefold. First, this study sought to gain understanding of the demographic characteristics and engagement practices of students attending Iowa community colleges. Second, it intended to gain understanding of the influence, if any, of engagement on students' intentions to transfer to a 4-year college or university and on students' STEM aspirations. Third, the study sought to add to the current body of literature on engagement, specifically as it pertains to community college engagement. This research also hopes to inform policy by providing relevant information on the influence of engagement at the community college level.

Research Questions

The following questions were used to guide this study:

1. What are the demographic and background characteristics of students in the SSSL study, students who intend to transfer to a 4-year institution, and students who have STEM aspirations?
2. How are student engagement constructs measured by variables in the SSSL survey?
3. Are there statistically significant differences between students who intend to transfer and students without transfer intentions, or between students with STEM aspirations and students without STEM aspirations based on their demographic characteristics?

4. Is there a correlation between engagement variables (peer engagement, faculty/staff encouragement/assistance, faculty engagement on coursework, and peer engagement) among students who intend to transfer or students with STEM aspirations?
5. To what extent do student demographics and student engagement levels predict students' intention to transfer?
6. To what extent do student demographics and student engagement levels predict students' STEM aspirations?

Hypotheses

Based on the review of the literature, two null hypotheses were established regarding the influence of student engagement on students' intention to transfer to a 4-year college or university and students' STEM aspirations.

H_0^1: There is no statistically significant relationship between student engagement and intention to transfer to a 4-year college or university.

H_0^2: There is no statistically significant relationship between student engagement and students' STEM aspirations.

Research Design

This research study was designed to be conducted in three phases:

- Phase 1: a review of larger regional and nationwide studies to determine constructs and questions to include in the SSSL survey instrument.
- Phase 2: a pilot study conducted at five Iowa community colleges.
- Phase 3: testing for reliability and validity and revising the SSSL survey instrument.

Phase 1: Initial Survey Design

A research team led by Dr. Soko Starobin, Iowa State University Assistant Professor and Director of the Office of Community College Research & Practice, reviewed and analyzed well-known survey instruments, including the CCSSE, National Survey of Student Engagement, Laanan Transfer Student Questionnaire, Transfer and Retention of Urban Community College Students, Survey of Undergraduate Research Experiences, and Cooperative Institutional Research Program, to establish survey questions that fall within the three SSSL study constructs of Self-Efficacy, Social Capital, and Transfer Knowledge. A listing of possible survey questions was established and then reviewed by the research team. All rights to use these questions, in full or in part, were obtained from the various sources. The team also consulted the IPEDS and the U.S. Census to assist in establishing appropriate survey response items that are widely used in higher education and national reporting.

The initial SSSL survey instrument (Appendix A) included 63 items that specifically examined variables associated with student engagement, self-efficacy, social capital, financial literacy, transfer knowledge, and general student demographics. Upon finalization of the survey instrument, permission for the Spring 2012 pilot study was sought and granted by the Iowa State University Institutional Review board on March 23, 2012.

Phase 2: Spring 2012 Pilot Study

During the spring 2012 semester, a pilot study of the SSSL survey instrument was conducted at five Iowa community colleges. Over a 3-week period, more than 4,000 students who were enrolled in a STEM-related course during the Fall 2011 or Spring 2012 semesters were invited to participate in the pilot study. Participants were sent an invitation e-mail including a link to participate in the survey using the Qualtrics online survey software.

Despite the relatively large number of invited participants, only 565 students responded to the survey.

The results of the pilot study indicated that more than half (60.8%) of the students intended to transfer to a 4-year institution, and 16.1% indicated that they had STEM aspirations. Regarding peer engagement, the largest percentage (32%) of students in the pilot study indicated that they somewhat agreed that they utilized peer engagement. Nearly two-thirds (64.6%) of pilot study respondents indicated that they somewhat agreed or agreed that they utilized advisors/counselors in the transfer process. Regarding faculty/staff encouragement/assistance and engagement, the largest percentage of pilot study students (31.9%) indicated that they disagreed that they utilized faculty/staff encouragement/assistance during their time at the college, and the largest percentage (35.4%) responded that they engaged with faculty regarding coursework a few times per semester (Myers, Starobin, Laanan, & Russell, 2012).

The Pearson correlation conducted for the pilot study indicated that students who engaged with one group on campus were more likely to engage with other on-campus groups and organizations. However, the analysis revealed that students who were more likely to be engaged with their peers were less likely to have transfer intentions. This result is indicative of Astin's (1993) findings that some aspects of peer engagement can negatively affect students' collegiate outcomes.

The independent samples *t*-tests based on the pilot study data revealed that significant differences existed between students who intended to transfer and major in STEM fields and those who did not. The *t*-test indicated that students who engaged more frequently with their peers and faculty/staff for encouragement or assistance were less likely to intend to transfer and major in a STEM field than were their peers who engaged less frequently with peers and faculty. The results also revealed that students who intended to transfer into STEM engaged with faculty on coursework more frequently than did students who did not intend to transfer and major in STEM fields (Myers et al., 2012).

Phase 3: Testing for Validity and Reliability

After the completion of the pilot study, the results were analyzed to test the validity and reliability of the instrument. A confirmatory factor analysis was conducted to measure the survey constructs Self-Efficacy, Social Capital, Transfer Knowledge, Student Engagement, and Financial Literacy. Due to the recentness of development of the SSSL survey, a confirmatory factor analysis was utilized to establish if meaningful conclusions could be drawn from the data gathered from the survey instrument. Questions that guided the confirmatory factor analysis included: "Is there multicollinearity among questions within the survey constructs?," "Do questions within the constructs correlate highly with each other?," and "If high correlations exist, could that correlation warrant the removal of a specific question?"

The confirmatory factor analysis revealed high factor loadings within the previously established constructs, suggesting that a number of the survey questions were very similar in nature. The results of the analysis were then used to remove survey items that produced high factor loadings within each of the constructs. If a question presented as an outlier, a factor loading below 0.6, the item was removed from the construct (Aron, Aron, & Coups, 2005; Mertler & Vannatta, 2010; Tabachnick & Fidell, 2007).

To test the reliability of the instrument, the pilot study responses were randomly divided into two subsets and a confirmatory factor analysis was conducted using each subset of data. The confirmatory factor analysis produced very high and, at times, identical Cronbach's alpha reliability coefficients and factor loadings between the two subsets. This indicated a high reliability of the instrument.

Survey Instrument

The final version of the SSSL Survey (Appendix B) was developed after reviewing commonly used and established national surveys, conducting a pilot study, and reviewing the pilot study data for reliability and validity. The instrument focuses on four key sections: self-efficacy, social capital, transfer knowledge, and demographics.

The self-efficacy section includes questions related to students' perceived academic worth, ability to make friends, and capacity to overcome academic obstacles. This portion of the survey includes questions regarding students' level of commitment; ability to make friends; level of anxiety; encouragement or advice received from peers, faculty, and staff members; and number of hours spent studying. Responses to most questions are on a Likert-type scale, but anxiety is measured on a scale of 1–10 and the most challenging class is categorized by subject area.

The social capital part of the survey seeks to ascertain information about students' parental income, level of parents' education, number of hours worked, number of dependents supported, influence of family and friends to this point in the students' education, and students' future educational goals. The responses to the majority of questions in the social capital section are on a Likert-type range.

The intention of the third section, transfer knowledge, is to better understand the students' level of engagement with peers, staff, and faculty members; use of academic services; and intention to transfer to another institution. This portion includes questions about students' interactions with counselors/advisors, their interactions with faculty members outside of the classroom, their transfer intentions, and their aspirations. Responses to most of the questions in this section are on a Likert-type range.

The final section, student demographics, seeks to gather basic demographic data about the respondents, including: gender, race, age, marital status, religion, and native language. The demographic portion of the survey also includes questions about the students' earned academic credentials, current enrollment status, number of math and science courses previously completed, and number of miles students live from their current college. The responses to the demographic questions are mostly categorical.

Setting

The SSSL survey was administered to students in all 15 of the Iowa community college districts during the Fall 2012 academic semester. The 15 Iowa community college districts were established around economic hubs within the state of Iowa. Each district serves between three and 11 counties, with the average region comprising all or most of six counties (Iowa Department of Education, 2011). The majority of Iowa community college districts have a main campus and then smaller alternate campuses or county service centers, but only two districts, Iowa Valley CC District and Iowa Western CC, are considered to be true multicampus colleges by the Katsinas-Lacey classifications of 2-year colleges (Carnegie Foundation for the Advancement of Teaching [Carnegie Foundation], n.d.; Hardy & Katsinas, 2007; Katsinas & Lacey, 1996).

Katsinas and Lacey (1996) classified public, associates-only-granting, 2-year colleges based on size, undergraduate profile, and basic location and size classifications. These classifications are used nationally to describe 2-year community colleges and were used for the sake of this study. The Carnegie Foundation (n.d.) classified the 15 Iowa community college districts into 16 individual community colleges:

- Area I: Northeast Iowa CC
- Area II: North Iowa Area CC
- Area III: Iowa Lakes CC
- Area IV: Northwest Iowa CC
- Area V: Iowa Central CC
- Area VI: Iowa Valley CC District, comprising Marshalltown CC and Ellsworth CC
- Area VII: Hawkeye CC
- Area IX: Eastern Iowa CC District
- Area X: Kirkwood CC
- Area XI: Des Moines Area CC
- Area XII: Western Iowa Tech CC
- Area XIII: Iowa Western CC
- Area XIV: Southwestern CC
- Area XV: Indian Hills CC
- Area XVI: Southeastern CC.

An Area VIII community college was established through the state of Iowa legislation, but the region rejected that addition of the community college. That region is now served by the Area I community college, Northeast Iowa CC.

Katsinas and Lacey (1996) classified 2-year colleges by size, based on full-time enrollment (FTE), into five categories: very small (<500), small (500–1,999), medium

(2,000–4,999), large (5,000–9,999), and very large (≥10,000). They also categorized 2-year institutions by full-time/part-time enrollment into four categories: higher part-time (≥60% part-time enrollment), mixed part-time/full-time (40–59% part-time enrollment), medium full-time (10–39% part-time enrollment), and higher full-time (>10% part-time enrollment). Finally, Katsinas and Lacey classified public 2-year institutions into three major categories and seven subcategories: rural (small, medium, or large), suburban (single campus or multicampus), or urban (single campus or multicampus). A brief Katsinas and Lacey analysis of Iowa's 15 community college districts includes:

- Size (full-time enrollment): Four of the community colleges are identified as small (Northwest Iowa CC, Marshalltown CC, Ellsworth CC, and Southwestern CC). The majority (nine) of Iowa 2-year colleges are classified as medium (Northeast Iowa CC, North Iowa Area CC, Iowa Lakes CC, Iowa Central CC, Hawkeye CC, Western Iowa Tech CC, Iowa Western CC, Indian Hills CC, and Southeastern CC). One community college is identified as large (Eastern Iowa CC District, consisting of three community colleges: Muscatine CC, Clinton CC and Scott CC), and two community colleges are classified as very large (Kirkwood CC and Des Moines Area CC).
- Undergraduate profile (% of part-time enrollment): The vast majority (14) of Iowa community colleges are classified as mixed part-time/full-time enrollment (Northeast Iowa CC, North Iowa Area CC, Iowa Lakes CC, Northwest Iowa CC, Iowa Central CC, Marshalltown CC, Hawkeye CC, Eastern Iowa CC District, Kirkwood CC, Des Moines Area CC, Western Iowa Tech CC, Iowa Western CC, Southwestern CC and Southeastern CC). Only two of the Iowa community colleges

are identified as medium full-time 2-year colleges (Ellsworth CC and Indian Hills CC).

- Basic classifications (location/size): The 15 Iowa community college districts are categorized into four basic classification areas. Four community colleges are identified as public, rural-serving, small (Northwest Iowa CC, Marshalltown CC, Ellsworth CC, and Southwestern CC). Public, rural-serving, medium describes six of the Iowa community colleges (Northeast Iowa CC, North Iowa Area CC, Iowa Lakes CC, Iowa Central CC, Indian Hills CC, and Southeastern CC). Four of the Iowa community colleges are identified as public, rural-serving, large colleges (Hawkeye CC, Kirkwood CC, Des Moines Area CC, and Western Iowa Tech CC). The remaining two Iowa colleges are classified as public, suburban, multicampus 2-year colleges (Eastern Iowa CC District and Iowa Western CC) (Carnegie Foundation, n.d.; Hardy & Katsinas, 2007; Katsinas & Lacey, 1996).

Each member of the SSSL research team was assigned to be the primary contact and research liaison for one or more Iowa community colleges. Individual contacts were made, college profiles were created, a timeline was established, and the surveys were finalized to best suit each participating institution or community college district.

Population and Sample

Members of the SSSL research team worked to establish criteria for the master student data file (Appendix C). The SSSL research team specifically worked with institutional researchers at each of the 15 Iowa community college districts to establish a listing of courses that enroll mostly second term students; courses offered only in the Fall 2012 semester that count toward degree attainment, financial aid or institutional credit and courses specifically related to NSF grant programs (i.e., Science, Technology, Engineering, and Mathematics Talent Expansion Program and Scholarships in Science, Technology, Engineering, and Mathematics). The institutional researchers were asked to specifically remove/exclude all courses that were level I in a sequence-based course (example: Composition I), remedial courses, late start/late enroll courses, noncredit courses, high school dual-enrollment courses, freshman seminar courses, lower-level ESL courses, independent study courses, individual instruction courses (example: piano lessons), and distance education courses (including Iowa Communications Network, hybrid, and online). Students enrolled in the specified courses were sent an online invitation from the president, vice president, or dean of their respective institution with a link to complete the survey using the online survey software Qualtrics.

The Iowa community college districts provided contact information for 43,964 students who were then invited to participate in the study. More than 6,000 students responded to at least some of the survey questions for a response rate of 13.7%. Individual community college response rates include: Northeast Iowa CC, 20%; North Iowa Area CC, 13.4%; Iowa Lakes CC, 11.7%; Northwest Iowa CC, 32.8%; Iowa Central CC, 11.5%; Marshalltown CC, 8.6%; Ellsworth CC, 7.1%; Hawkeye CC, 43.5%; Eastern Iowa CC District, 12.4%; Kirkwood CC, 10.5%; Des Moines Area CC, 14.4%; Western Iowa Tech CC, 21.5%; Iowa Western CC, 17.8%; Southwestern CC, 7.8%; Indian Hills CC, 9%; and Southeastern CC, 9.6%. After removing the students who logged into the study but did not complete the study, the final sample size was 5,140 students.

To further analyze the data, the sample was divided into two subsamples: (a) students who intended to transfer and (b) students with STEM aspirations. The subsample intention to transfer had a sample size of 2,707 students who responded that they intend to transfer to a 4-year public or private college or university. The STEM aspirations subsample comprised survey responses from 1,040 students who indicated that they planned to major in a STEM field. The subsamples intention to transfer and STEM aspirations were independent of each other, meaning that students with STEM aspirations did not have to indicate that they intended to transfer to a 4-year institution.

Data Collection

The survey was administered to students at the 15 Iowa Community College Districts using the Qualtrics survey software. The SSSL research team worked with the community college district, college administrators, and institutional research personnel to obtain the names and corresponding e-mail addresses for students enrolled in the Fall 2012 semester. At the onset of the survey, an e-mail was sent to all students providing them with a brief background of the study as well as a link to access the Qualtrics survey. Hawkeye CC was the first college to participate in the survey, and it opened on October 1, 2012. Each survey was open for 2 weeks. Indian Hills CC was the last college to complete the survey, and it closed on December 3, 2012. The full timeline for the study can be found in Appendix D. To encourage participation, a drawing was held and the winner received an iPad.

Theoretical Framework

Astin's (1993) theory of student involvement, better known to some as the I–E–O theory of engagement, was the guiding theoretical framework for this study. In this study, the input (I) variables were the background and demographic characteristics that students brought with them to the collegiate setting. As shown in Figure 3.1, input variables in this study included age, gender, ethnicity, native language, mother's education, father's education, level of math completed, and level of science completed. Environmental (E) variables included in this study were peer engagement, faculty or staff encouragement and assistance, faculty engagement on coursework, and transfer engagement. Output (O) variables for this study included intention to transfer to a 4-year college or university and STEM aspirations. Utilizing this theoretical framework allowed the researcher to determine if specific input or environmental variables have a direct influence on the output variables. It

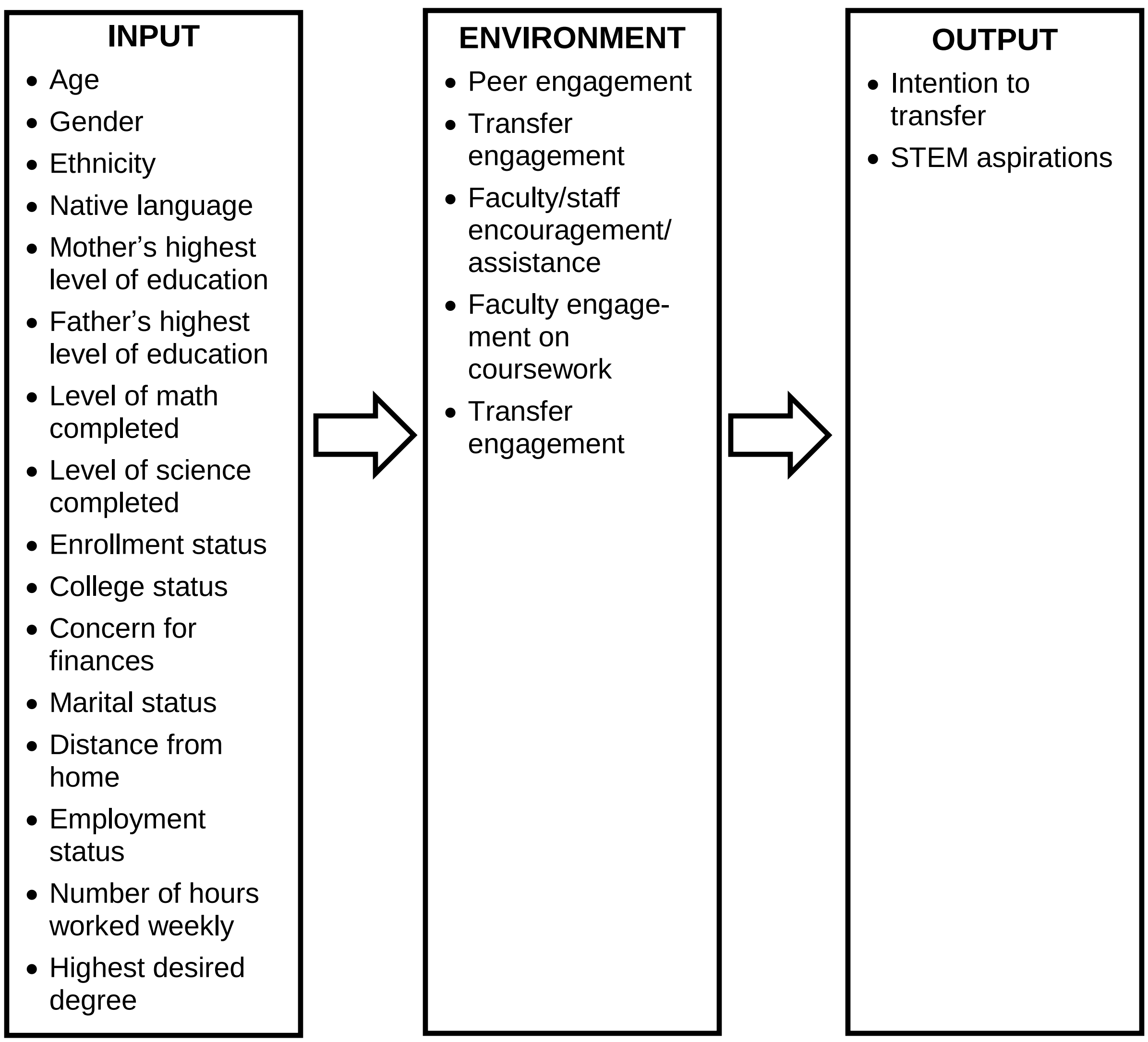

Figure 3.1. Implementing Astin's (1993) theory of involvement.

also allowed the researcher the ability to control one or more of the input variables and assess the influence of the environmental variables on the outcome variables.

Variables in the Study

The purpose of this study was to examine the influence of engagement and demographic characteristics on students' intentions to transfer and on STEM aspirations. This study focused on a two-tier analysis based on the dependent variables, intention to transfer and STEM aspirations, as well as on 35 independent variables.

Dependent Variables

The dependent variable intention to transfer sought to measure the students' intention to transfer to a 4-year college or university. This variable was studied using student responses for Question 45 and was recoded as 0 = students who did not intend to transfer to a 4-year college or university and 1 = students who did intend to transfer to a 4-year college or university. This variable was used to analyze the difference in engagement practices for students who intended to transfer to a 4-year institution and those students without transfer intentions.

The second dependent variable, STEM aspirations, was used to analyze students' aspirations to major in a STEM-related field. This variable was studied using student responses for Question 46 and was recoded as 0 = students who did not have STEM aspirations and 1 = students who had STEM aspirations. The STEM aspirations variation was used to attempt to identify the differences in engagement between students who do not and those who do have STEM aspirations.

Independent Variables

To answer the research questions for this study, a number of independent and mediating variables were employed for the descriptive, correlation, comparative, and logistic regression analyses. The independent variables were categorized into five blocks. Block 1 (B^1) included demographic and background information, Block 2 (B^2) consisted of peer engagement variables, Block 3 (B^3) included variables associated with faculty/staff encouragement/assistance, Block 4 (B^4) consisted of variables associated with faculty engagement on coursework, and Block 5 (B^5) included transfer engagement variables.

Numerous researchers in the field of student engagement have made note of the influence of student input or background characteristics on student outputs or outcomes (Astin, 1993; Kuh et al., 2010; Pascarella & Terenzini, 1991, 2005; Weidman, 1989). The following independent variables in Block 1 were used to help analyze the influence of student demographic characteristics on students' Intention to Transfer and STEM aspirations.

- *Age (*B^1*)* was analyzed using responses to Question 57. The information was recoded into age ranges of 18–24 years of age, 25–39 years of age, and ≥ 40years of age and was coded as 1 = ≤24, 2 = 25–39, and 3 = ≥40. Students between the 18 and 24 years of age were considered traditional-age students.
- *Gender (*B^1*)* was studied using responses to Question 55. The variable was dummy coded as 0 = male and 1 = female.
- *Ethnicity (*B^1*)* was evaluated utilizing responses to Question 56 and was coded as 1 = American Indian/Alaskan Native, 2 = Asian, 3 = Black/African American, 4 = Hispanic, 5 = Native Hawaiian/Pacific Islander, 6 = White, 7 = two or more races, and 8 = unknown.

- *Native language (*B[1]*)* was studied utilizing responses to Question 65 and was dummy coded as 0 = no and 1 = yes.
- *Mother's education (*B[1]*)* was analyzed using responses to Question 17_1. The variable was coded as 1 = elementary or less, 2 = some high school, 3 = high school graduate, 4 = some college, 5 = associate's degree from a 2-year college, 6 = bachelor's degree, 7 = some graduate school, 8 = graduate degree, 9 = don't know.
- *Father's education (*B[1]*)* was studied using responses to Question 17_2 and was coded as 1 = elementary or less, 2 = some high school, 3 = high school graduate, 4 = some college, 5 = associate's degree from a 2-year college, 6 = bachelor's degree, 7 = some graduate school, 8 = graduate degree, 9 = don't know.
- *Level of math completed (*B[1]*)* was evaluated using responses to Questions 50_1_1, 50_1_2, 50_2_1, 50_2_2, 50_3_1, 50_3_2, 50_4_1, 50_4_2, 50_5_1, 50_5_2, 50_6_1, 50_6_2, 50_7_1, 50_7_2, 50_8_1, 50_8_2, 50_9_1, and 50_9_2. The questions were computed and then recoded into three categories: low, medium, and high math. Low math (0–6 math courses taken) was coded as 1, medium math (7–12 math courses taken) was coded as 2, and high math (13–18 math courses taken) was coded as 3.
- *Level of science completed (*B[1]*)* was analyzed using responses to Questions 51_1_1, 51_1_2, 51_2_1, 51_2_2, 51_3_1, 51_3_2, 51_4_1, 51_4_2, 51_5_1, 51_5_2, 51_6_1, and 51_6_2. The questions were computed and then recoded into three categories: low, medium, and high science. Low science (0–4 science courses taken) was coded as 1, medium science (5-8 science courses taken) were coded as 2, and high science (9–12 science courses taken) was coded as 3.

- *Enrollment status* (B^1) was analyzed using responses to Question 49. The variable was dummy coded as 0 = part-time and 1 = full-time enrollment.
- *College status* (B^1) was analyzed using responses to Question 48 and was dummy coded as 0 = first-time college student and 1 = not a first-time college student.
- *Concern for finances* (B^1) was studied utilizing responses to Question 21. The variable was coded as 1 = none, 2 = some concern and 3 = major concerns.
- *Marital status* (B^1) was analyzed using responses to Question 58 and was coded as 1 = married, 2 = living together (not married), 3 = single, never married, and 4 = divorced/separated/widowed.
- *Distance from home* (B^1) was studied utilizing responses to Question 61. The variable was computed and recoded as 1 = 0–50 miles, 2 = 51–100 miles, 3 = 101–500 miles, and 4 = more than 500 miles.
- *Employment status* (B^1) was studied using responses to Question 23. The variable was coded as 1 = yes, I am currently working on campus, 2 = yes, I am currently working off campus, 3 = no, I am not looking for working opportunities, 4 = no, I am currently unemployed, but I am looking for working opportunities.
- *Number of hours worked for pay weekly* (B^1) was analyzed using responses to Question 24 and was coded as 1 = 1–10 hours per week, 2 = 11–15 hours per week, 3 = 16–20 hours per week, 4 = 21–30 hours per week, and 5 = more than 30 hours per week.
- *Highest desired degree* (B^1) was studied utilizing responses to Question 33. The variable was coded as 1 = will take classes, but do not intend to earn a degree; 2 = vocational certificate/degree; 3 = associate's degree (A.A. or equivalent); 4 =

bachelor's degree (B.A., B.S., etc.); 5 = at least a bachelor's degree, maybe more; 6 = master's degree (M.A., M.S., etc.); 7 = doctoral degree (Ph.D., Ed.D., J.D., etc.); and 8 = medical degree (M.D., D.D.S., D.V.M., etc.).

The premise behind most research on student engagement is the understanding of the types of engagement experiences (known here as constructs) that influence students' decision-making processes while attending college. Much of the current research produced from the CCSSE and the National Survey of Student Engagement are based on five constructs. This study focused on four distinct constructs, consisting of 19 specific questions, related to Peer Engagement (B^2), Faculty/Staff Encouragement/Assistance (B^3), Faculty Engagement on Coursework (B^4), and Transfer Engagement (B^5).

- *Peer Engagement* (B^2) was computed and studied utilizing responses to Questions 14_10, 15_2, 15_3, and 15_4. The Peer Engagement construct sought to analyze the usefulness of students' engagement with their peers in terms of encouragement, advice, and assistance on coursework. This construct was analyzed with responses on a Likert-type scale ranging from 1 (*did not use or receive/not applicable*) to 4 (*used/received, very helpful*).
- *Faculty/Staff Encouragement/Assistance* (B^3) was computed and evaluated utilizing responses to Questions 15_5, 15_7, 15_8, 15_9, and 15_10. The Faculty/Staff Encouragement/Assistance construct sought to understand students' feelings toward the usefulness of engagement with faculty or staff for encouragement or assistance. This construct was analyzed with responses on a Likert-type scale ranging from 1 (*never or very rarely*) to 5 (*several times a week*) or 1 (*did not use or receive/not applicable*) to 4 (*used/received, very helpful*).

- *Faculty Engagement on Coursework* (B^4) was computed and studied using responses to Questions 40_1, 40_2, 40_5, and 40_6. This construct sought to understand the amount of time students spend engaging with faculty members outside of their normal classroom activities and was analyzed with responses on a Likert-type scale ranging from 1 (*never or very rarely*) to 5 (*several times a week*).
- *Transfer Engagement* (B^5) was computed and evaluated utilizing Questions 38_1, 38_2, 38_3, 38_4, 38_5, and 38_6. This construct sought to analyze students' beliefs on the usefulness of academic advising/counseling at the community college and particularly, on the use of those services in terms of assisting with transferring to a 4-year college or university. Transfer Engagement was analyzed with responses on a Likert-type scale ranging from 1 (*neither agree nor disagree*) to 8 (*strongly agree*).

A complete listing of the variables utilized in this study can be found in the codebook in Appendix E.

Data Analysis

The variables and data included in this study were quantitatively analyzed using IBM SPSS 20.0 and AMOS 20.0 software. Data analysis, including descriptive, correlation, comparative and inferential statistics, was utilized to answer the study's research questions.

Descriptive Statistics

Background and demographic data were analyzed using frequencies and cross-tabulations to provide a better understanding of community college students. Background and demographic variables analyzed included age, ethnicity, gender, native language, mother's education, father's education, level of math completed, level of science completed, enrollment status, college status, concern for finances, marital status, distance from home, employment status, number of hours worked for pay weekly, and highest desired degree. The constructs associated with engagement (Peer Engagement, Transfer Engagement, Faculty/Staff Encouragement/Assistance, and Faculty Engagement on Coursework) were descriptively analyzed to provide an in-depth analysis of the frequency at which students engage in the collegiate learning environment.

Exploratory/Confirmatory Factor Analysis

An exploratory factor analysis was conducted to determine if any intercorrelations existed between variables related to engagement. Eighteen questions were entered into the exploratory factor analysis using SPSS 20.0. The questions included in the exploratory factor analysis that produced factor loadings greater than .50 were retained in the model (Mertler & Vannatta, 2010). The constructs were analyzed on their Cronbach's alpha reliability, and constructs with a Cronbach's alpha greater than. 60 were retained (Mertler & Vannatta, 2010). The 18 questions included in the exploratory factor analysis produced four engagement constructs, which were then used in the confirmatory factor analysis.

The confirmatory factor analysis was conducted using AMOS 20.0 software. The four constructs and 18 variables produced through the exploratory factor analysis were included in the confirmatory factor analysis. To conduct a confirmatory factor analysis using the AMOS software, a dataset must be complete and without missing data. The data for this study was not found to be missing at random. AMOS's full information maximum likelihood (FIML) estimation imputation method was used for the missing data. The FIML imputation method uses all existing data and the multivariate normal model of joint distribution of the variables to compute the likelihood of the observed data as a function of the parameters of the fixed observed data and estimate the parameters that maximize this likelihood (Little & Rubin, 1989). The Bayesian approach also was tested on the variables included in the model, as the Bayesian method is often recommended when analyzing categorical data (Garson, 2012). The results produced through the FIML and the Bayesian approaches produced similar results, and the FIML method provided through AMOS was used in this study.

The confirmatory factor analysis was analyzed on the chi-square goodness-of-fit and the model fit indices: GFI (goodness-of-fit index), CFI (Bentler's comparative fit index) and RMSEA (root mean square error of approximation). When evaluating the chi-square goodness-of-fit test on a sample size this large (N = 5,140), one must take into consideration that chi-square tests are very sensitive to large sample sizes and, therefore, it is important to utilize other goodness-of-fit indices to analyze the results of the confirmatory factor analysis (Tabachnick & Fidell, 2007). Both GFI and CFI were evaluated on the model-fit expectation set forth by Hu and Bentler (1998) indicating that models with GFI and CFI indices greater than .95 are preferred results. A perfect RMSEA result would produce a model fit of zero, but Hu and Bentler (1999) suggested a value less than .06 as appropriate for testing model fit in a confirmatory factor analysis.

Comparative Analysis

A comparative analysis was conducted to determine if statistically significant differences existed between the means of the variables associated with engagement and students' intentions to transfer or between the means of variables associated with engagement and students' STEM aspirations. Cross-tabulations and Pearson chi-square analysis, Mann-Whitney U tests, and independent samples *t*-tests were used to compare the means of the variables in the study based on the dependent variables. The type of comparative analysis utilized was based on the type of variable to be analyzed (nominal, ordinal, or dichotomous).

All nominal and dichotomous variables were analyzed using the nonparametric cross-tabulations and Pearson chi-square analyses. The phi coefficient and Cramer's *V* were used to determine significance between the independent variables and the dependent variables, intention to transfer and STEM aspirations. The phi coefficient was utilized for dichotomous variables in a 2 × 2 cross-tabulation and Cramer's *V* was used for nominal variables that resulted in larger cross-tabulations.

Ordinal variables in the study were analyzed using the independent samples *t*-test or the Mann-Whitney U test, based on the normality of the variable. Each ordinal variable was analyzed on each of the dependent variables to establish normality specific to the variables intention to transfer and STEM aspirations. There are three main assumptions of the independent samples *t*-test that variables must not markedly violate:

1. The variances of the dependent variable in the population are equal,
2. The dependent variable is normally distributed within each population, and
3. The data are independent (Morgan et al., 2007, pp. 143–144).

The assumption of equal variances was analyzed through the use of Levene's test for equality of variances. A significant ($p \leq .05$) result of the Levene's test indicates that the variances of the dependent variables are significantly different and that the assumption of equal variances is markedly violated (Morgan et al., 2007; Urdan, 2010). The assumption of normality was evaluated based on the skewness of the ordinal variables. Traditionally skewness between –1 and 1 has been deemed appropriate (Aron et al., 2005; Mertler & Vannatta, 2010; Morgan et al., 2007; Tabachnick & Fidell, 2007; Urdan, 2010). Variables with skewness less than –1 or greater than 1 markedly violate the assumption of normality. Variables that met the assumptions of the independent samples *t*-test were analyzed using the *t*-test, whereas variables that markedly violated the assumptions were evaluated through the use of the Mann-Whitney U test.

The non-parametric Mann-Whitney U test is a comparative analysis of the observations from one group (i.e. students who intend to transfer or students with STEM aspirations) to the observations from a second group (i.e. students who do not intend to transfer or students without STEM aspirations). The Mann-Whitney U test transforms the data into ranks and then compares the mean rank of the data for each group. Significant differences exist between the two groups if the mean rank of one group is statistically significantly larger than the mean rank of the other group (Nachar, 2008). The following formula is used to calculate the U statistic:

$$U = n_1 n_2 + \frac{n_2(n_2+1)}{2} - \sum_{i=n_1+1}^{n2} R_i$$

Correlation Analysis

A Pearson correlation was conducted to determine if statistically significant correlations existed between variables associated with engagement: peer engagement, transfer engagement, faculty/staff encouragement/assistance, and faculty engagement on coursework.

The statistically significant correlations (at the $p < .05$ level) were analyzed based on the corresponding correlation coefficient (r), which indicates the direction (positive or negative) of the association between the variables while the coefficient of determination (r^2) signified the proportion of variability from one variable to another. A positive Pearson correlation indicates that the scores of the variable move in the same direction (positive or negative), whereas a negative correlation indicates that as one variable's score increases the other variable's score decreases (Mertler & Vannatta, 2010; Urdan, 2010).

Logistic Regression Analysis

To determine the extent to which engagement can be used to predict students' intentions to transfer to a 4-year college or university and students' STEM aspirations, two logistic regression analyses were conducted using intention to transfer and STEM aspirations as the dependent variables and five blocks of independent variables. The first block of independent variables included the demographic, or input, characteristics. The other four blocks in the study were based on the constructs established through the exploratory and confirmatory factor analyses. Logistic regression analysis was chosen as the type of inferential statistics included in this study because the dependent variables, intention to transfer and STEM aspirations, were dichotomous variables (Aron et al., 2005; Mertler & Vannatta, 2010).

Ethical Considerations

Studies conducted using human participants must be administered within the policies established by the Institutional Review Board (IRB; Creswell, 2009). Therefore, prior to administering the survey, the SSSL research team applied for and was granted approval by the Iowa State University IRB. The research team was granted exempt status, and the IRB application was approved on March 23, 2012 (Appendix F).

Each of the participating institutions was provided a copy of the Iowa State University IRB application and the approval letter prior to the onset of the survey. All questions regarding IRB status by the participating institutions were answered in entirety prior to conducting the survey.

All responses to the study's survey remain confidential. Each respondent was provided with a unique identifier, and all personal data (name and e-mail address) were removed from the dataset. The researchers worked closely with the Iowa State University Office of Community College Research & Practice to ensure that all possible measures were exhausted to ensure confidentiality of all respondents throughout the course of the study.

Limitations

There are five obvious limitations of this study. The first limitation is that the SSSL survey, while reduced, is still extremely long and requires the students to respond to more than 130 survey items. The length of the survey may have led to students beginning the survey and dropping out at various points throughout the survey. A high response rate is important for any study and increases the robustness of the survey findings.

The second limitation of the study is that students were asked to self-report their parents' income, completed coursework, academic goals, and future intentions. The self-reporting aspect of this survey could have led students to misrepresent themselves or their intentions and, therefore, skew the data. Relying on students to honestly self-report the data derived from the survey could skew the data and, therefore, is a significant limitation of the study.

The third limitation is that this study was conducted at 15 small rural community colleges in the state of Iowa. Although this population provided a large sample for the study, the results are not generalizable to all community college in the United States. The students in the study also are not representative of all small rural community colleges in the country.

The results of this study, however, can be generalizable to small, rural community colleges in the Midwest.

The fourth limitation is that students' intention to transfer and STEM aspirations were self-reported and, therefore, the results were not based on longitudinal data. Students may have misrepresented their intentions or abilities through the self-reporting process and that may have skewed the data. A follow-up study using longitudinal data to determine if students did follow through with their plans to transfer or major in a STEM field could add to the robustness of the data included in this analysis.

The last limitation of this study is the generalizability of the results to community college students in other areas of the United States. The students attending Iowa's community colleges are largely Caucasian, traditional age, native English-speaking students from rural areas. The students included in this study have very little in common with students attending community colleges in large urban areas; therefore, the results are not generalizable to all community college students in the United States. Despite this, the findings are relatable to other small, rural, midwestern community colleges. The study is a basis for further research in the field of community college student engagement with hopes to spur future studies that may produce results generalizable to that of all community college students in the United States.

Delimitations

This study was delimited to students attending one of the 15 Iowa community college districts. It was delimited to students enrolled during the Fall 2012 semester who were not dual-enrolled high school students and who were not enrolled solely on an online basis. All students attending Iowa community colleges who were not dual-enrolled high school students or online-only students were invited to participate in the study regardless of graduation intentions, transfer intentions, or current program of study.

Summary

This study sought to understand the relationship between student engagement and student transfer intentions and STEM aspirations of Iowa community college students. This multilevel dichotomous study employed a number of quantitative research methods.

This chapter included an overview of the methodology guiding the study, including the research questions, hypotheses, research design, survey instrument, setting, population and sample, data collection, theoretical construct, variables in the study, data analysis, ethical considerations, limitations, and delimitations.

The following two chapters provide an overview of the research findings as well as a discussion of the significance of the results and possible implications of the study for policy, practice and future research. It was the intention for this study to add to the current body of knowledge on community college student engagement as well as provide community colleges with best practices to use in engaging students to promote transfer to a 4-year college or university and STEM aspirations.

CHAPTER 4. RESULTS

Introduction

This chapter provides an overview of the results of the data analysis. The results of the data analyses are provided in seven sections that correspond with the six research questions that guided this study and a concluding summary section.

The first section provides a summary of the demographic and background characteristics of all students in the SSSL study as well as frequencies of students who intended to transfer to a 4-year institution and frequencies for students with STEM aspirations. The second section summarizes the results of the exploratory factor analyses and establishes the engagement constructs used throughout the study. This section also includes the findings of the confirmatory factor analysis and establishes the community college student engagement model.

The third section determines whether significant differences exist between students who intended to transfer and students with no transfer intentions, or between students with STEM aspirations and students who did not have STEM aspirations based on the demographic variables age, gender, ethnicity, native language, mother's education, father's education, level of math completed, level of science completed, marital status, concern for finances, distance from home, and hours worked. The fourth section identifies if statistically significant correlations exist between the community college student engagement constructs Peer Engagement, Faculty/Staff Encouragement/Assistance, Faculty Engagement on Coursework, and Transfer Engagement.

The fifth section discusses the results of the logistic regression analysis and provides a summary of the extent to which student background and engagement predicts students' intention to transfer. The sixth section summarizes the results of the logistic regression analysis and provides an overview of the extent to which engagement predicts students' STEM aspirations.

The final section provides a summary of the findings included in the chapter and prepares the reader for the final chapter in this study: a discussion of the results and implications for policy, practice and future research.

The following questions were used to guide this study:

1. What are the demographic and background characteristics of students in the SSSL study, students who intend to transfer to a 4-year institution and students who have STEM aspirations?
2. How are student engagement constructs measured by variables in the SSSL survey?
3. Are there statistically significant differences between students who intend to transfer and students without transfer intentions, or between students with STEM aspirations and students without STEM aspirations based on their demographic characteristics?
4. Is there a correlation between engagement variables among students who intend to transfer or students with STEM aspirations?
5. To what extent do student demographics and student engagement levels predict students' intention to transfer?
6. To what extent do student demographics and student engagement levels predict students' STEM aspirations?

Descriptive Analysis

The demographics of students participating in the SSSL study were descriptively analyzed based on age, gender, ethnicity, native language, mother's education, father's education, level of math completed, level of science completed, concern for finances, marital status, distance from home, hours worked, intention to transfer, STEM aspirations, enrollment status, college status, peer engagement, transfer engagement, faculty engagement on coursework, and faculty/staff encouragement/assistance. The descriptive analysis was analyzed in three parts: (a) all survey respondents, (b) students with transfer intentions and (c) students with STEM aspirations. A summary of the descriptive analysis of all variables is provided in Table 4.1.

Table 4.1

Demographic Descriptive Analysis

	All students		Intention to transfer		STEM aspirations	
Variables	*n*	%	*n*	%	*n*	%
Gender						
Male	1,278	27.3	799	29.8	390	37.9
Female	3,404	72.7	1,884	70.2	638	62.1
Missing (nonresponse)	458		24		12	
Age						
18-24	2,111	45.1	1,409	52.6	479	46.6
25-39	1,696	36.2	901	33.6	381	37.1
≥40	876	18.7	371	13.8	167	16.3
Missing (nonresponse)	457		26		13	
Race/ethnicity						
American Indian/Alaskan Native	33	0.7	24	0.9	9	0.9
Asian	91	1.9	69	2.6	34	3.3
Black/African American	191	4.1	135	5.0	53	5.1
Hispanic	122	2.6	72	2.7	31	3.0
Native Hawaiian or Pacific Islander	10	0.2	5	0.2	2	0.2
White	4,037	86.1	2,259	83.9	853	82.7
Two or more races	161	3.4	99	3.7	36	3.5
Unknown	43	0.9	29	1.1	13	1.3
Missing (nonresponse)	452		15		9	

Table 4.1 (continued)

Variables	All students n	All students %	Intention to transfer n	Intention to transfer %	STEM aspirations n	STEM aspirations %
Native language						
English	4,448	95.0	2,505	93.5	931	90.7
Other (non-English)	235	5.0	175	6.5	96	9.3
Missing (nonresponse)	457		27		13	
Marital status						
Married	1,303	27.8	632	23.5	271	26.4
Living together (not married)	658	14.1	358	13.4	129	12.5
Single, never married	2,169	46.4	1,426	53.2	509	49.6
Divorced/separated/widowed	549	11.7	265	9.9	118	11.5
Missing (nonresponse)	461		26		13	
Current employment						
Working on campus	303	6.0	189	7.0	69	6.7
Working off campus	3,111	62.1	1,731	64.0	629	60.5
Not working and not looking for work	649	13.0	314	11.6	133	12.8
Unemployed, but looking for work	945	18.9	469	17.4	208	20.0
Missing (nonresponse)	132		4		1	
Number of hours worked						
1–10 hours per week	430	12.8	238	12.5	95	13.6
11–15 hours per week	323	9.6	181	9.5	68	9.8
16–20 hours per week	532	15.8	319	16.6	125	17.9
21–30 hours per week	788	23.4	467	24.4	158	22.6
>30 hours per week	1,292	38.4	706	37.0	252	36.1
Missing (nonresponse)	1,775		796		342	100.0
Highest level of education completed by father						
Elementary school or less	182	3.6	73	2.7	34	3.3
Some high school	489	9.7	237	8.8	102	9.9
High school graduate	1,845	36.5	931	34.6	351	33.9
Some college	804	15.9	467	17.4	187	18.1
Associate’s degree from 2-year college	606	12.0	324	12.0	116	11.2
Bachelor’s degree	556	10.9	340	12.6	122	11.8
Some graduate school	40	0.8	20	0.7	13	1.2
Graduate degree	274	5.4	174	6.5	69	6.7
Don’t know	262	5.2	127	4.7	40	3.9
Missing (nonresponse)	82		14		6	
Highest level of education completed by mother						
Elementary school or less	140	2.8	75	2.8	40	3.9
Some high school	400	7.9	172	6.4	71	6.9
High school graduate	1,565	31.1	759	28.3	289	28.1
Some college	956	19.0	526	19.6	197	19.2
Associate’s degree from 2-year college	897	17.8	513	19.1	186	18.1
Bachelor’s degree	628	12.5	387	14.5	145	14.1
Some graduate school	73	1.4	40	1.5	20	1.9
Graduate degree	288	5.7	169	6.3	69	6.7
Don’t know	93	1.8	39	1.5	11	1.1
Missing (nonresponse)	100		27		12	

Table 4.1 (continued)

Variables	All students		Intention to transfer		STEM aspirations	
	n	%	*n*	%	*n*	%
Level of math completed						
Low	4,026	78.3	1,968	72.7	663	63.7
Medium	1,091	21.2	725	26.8	364	35.0
High	23	0.4	14	0.5	13	1.3
Missing (nonresponse)	0		0		0	
Level of science completed						
Low	3,551	69.1	1,682	62.1	538	51.7
Medium	1,509	29.4	978	36.1	466	44.8
High	80	1.6	47	1.8	36	3.5
Missing (nonresponse)	0		0		0	
Distance from college to home						
<50 miles	4,055	86.5	2,319	86.3	880	85.6
51–100 miles	393	8.4	204	7.6	91	8.9
101–500 miles	184	3.9	121	4.5	41	4.0
>500 miles	58	1.2	42	1.6	16	1.5
Missing (nonresponse)	450		21		12	
Enrollment status						
Part time	1,414	30.1	718	26.7	281	27.3
Full time	3,277	69.9	1,974	73.3	748	72.7
Missing (nonresponse)	449		15		11	
College status						
First semester	705	15.0	439	16.3	149	14.5
Not first semester	3,986	85.0	2,251	83.7	881	85.5
Missing (nonresponse)	449		17		10	
Intention to transfer						
Yes	2,707	57.6	2,707	100.0	883	85.1
No	1,992	42.4	0	0.0	154	14.9
Missing (nonresponse)	441		0		3	
STEM aspirations						
Yes	1,040	22.2	883	32.8	1,040	100.0
No	3,639	77.8	1,807	67.2	0	0.0
Missing (nonresponse)	46		17		0	
Intended STEM major						
Biology	114	11.2	103	12	113	11.4
Engineering	134	13.2	119	13.9	131	13.3
Physical science	39	3.8	36	4.2	39	3.9
Health related	443	43.5	360	42.1	433	43.8
Technology	72	7.1	52	6.1	68	6.9
Computer science	91	8.9	80	9.3	89	9.0
Military science	2	0.2	1	0.1	2	0.2
Forestry	6	0.6	4	0.5	6	0.6
Other STEM	117	11.5	101	11.8	108	10.9
Missing (nonresponse)	4,122		1,851		51	

Table 4.1 (continued)

Variables	All students *n*	All students %	Intention to transfer *n*	Intention to transfer %	STEM aspirations *n*	STEM aspirations %
Highest desired academic degree						
Will take classes, no intention to earn degree	10	0.2	2	0.1	1	0.1
Vocational certificate	72	1.5	3	0.1	8	0.8
Associate's degree (AA or equivalent)	513	10.5	37	1.4	31	3.0
Bachelor's degree (BA/BS, etc.)	733	15.0	297	11.0	103	9.9
At least a Bachelor's degree, maybe more	1,396	28.6	794	29.4	268	25.8
Master's degree (MA, MS, etc.)	1,142	23.4	796	29.5	255	24.5
Doctoral degree (Ph.D., Ed.D., J.D.)	710	14.6	574	21.2	258	24.9
Medical degree (M.D., D.D.S., D.V.M.)	298	6.1	197	7.3	114	11.0
Missing (nonresponse)	266		7		2	
Concern for finances						
None	1,202	24.0	567	21.0	215	20.7
Some	2,564	51.3	1,400	51.9	529	51.0
Major	1,235	24.7	732	27.1	294	28.3
Missing (nonresponse)	139		8		2	
Peer engagement						
Did not use/receive	1,393	28.0	744	28.4	254	25.1
Used/received, not helpful	1,474	29.7	765	29.1	286	28.2
Used/received, somewhat helpful	1,598	32.1	842	32.1	357	35.3
Used/received, very helpful	508	10.2	274	10.4	115	11.4
Missing (nonresponse)	167		82		28	
Transfer engagement						
Neither agree nor disagree	316	6.7	134	5.0	51	5.0
Strongly disagree	699	14.9	293	11.0	125	12.2
Disagree	1,051	22.4	424	15.9	175	17.1
Slightly disagree	884	18.8	456	17.1	190	18.5
Slightly agree	743	15.8	516	19.3	191	18.6
Agree	627	13.3	522	19.6	173	16.9
Strongly agree	381	8.1	324	12.1	120	11.7
Missing (nonresponse)	439		38		15	
Faculty/staff encouragement or assistance						
Did not use/receive	2,321	46.9	1,220	46.4	441	43.5
Used/received, not helpful	1,897	38.3	1,022	38.9	421	41.6
Used/received, somewhat helpful	602	12.1	312	11.9	115	11.3
Used/received, very helpful	135	2.7	73	2.8	36	3.6
Missing (nonresponse)	185		80		27	100.0
Faculty engagement on coursework						
Never	509	10.8	279	10.4	83	8.1
Few times per semester	1,711	36.4	959	35.9	364	35.5
Once a month	1,116	23.8	635	23.7	253	24.7
Several times per month	936	19.9	540	20.2	213	20.8
Several times per week	429	9.1	261	9.8	111	10.9
Missing (nonresponse)	439		33		16	

All SSSL Survey Respondents

The total number of respondents to the SSSL survey was 5,140 Iowa community college students. Background demographic data on the SSSL respondents were analyzed in three subcategories: background demographics, collegiate information and engagement.

Background demographics. The majority (72.3%, *n* = 3,404) of survey respondents were female and 27.7% (*n* = 1278) were male. The largest percentage of students (45.1%, *n* = 2,111) were traditional-age college students, between 18 and 24 years of age, whereas 36.2% (*n* = 1,696) were 25–39 years old and 18.7% (*n* = 876) were at least 40 years old. An overwhelming majority of SSSL respondents identified as White/Caucasian (86.1%, *n* = 4,037), 4.1% (*n* = 191) reported their ethnicity as African American/Black, 3.4% (*n* = 161) identified as two or more races, and 2.6% (*n* = 122) responded as Hispanic. Asian (*n* = 91), American Indian/Alaskan Native (*n* = 33), unknown (*n* = 43) and Native Hawaiian/Pacific Islander (*n* = 10) each made up less than 2% of the sample. English was the native language for most (95%, *n* = 4448) students in the study. The largest percentage (46.4%, *n* = 2,169) of the respondents indicated that they were single or never married, 27.8% (*n* = 1,303) indicated that they were currently married, 14.1% (*n* = 658) were living together, but not married, and 11.7% (*n* = 549) were divorced, separated or widowed.

The majority (62.1%, *n* = 3,111) of students were working at a job for pay off campus, 18.9% (*n* = 945) were unemployed but looking for work, 13% (*n* = 649) were not working and not looking for work, and 6% (*n* = 303) were working on campus. Of the students who indicated that they are working, 38.4% (*n* = 1,292) were working more than 30 hours per week, 23.4% (*n* = 788) between 21 and 30 hours per week, 15.8% (*n* = 532) 16–

20 hours per week, 12.8% (*n* = 430) 10 or fewer hours per week, and 9.6% (*n* = 323) 11–15 hours per week.

For more than one in three students (36.5%, *n* = 1,845), their father's highest level of education was high school graduate, 804 (15.9%) students indicated their father's highest level of education was some college, 12% (*n* = 606) reported their father's highest level as an associate's degree from a 2-year college, and 10.9% (*n* = 556) indicated that a bachelor's degree was their father's highest level of completed education. Less than 10% of students indicated that their father's highest level of education was some high school (*n* = 489), a graduate degree (*n* = 274), didn't know (*n* = 262), elementary school or less (*n* = 182), and some graduate degree (*n* = 40). As with their father's highest level of education, the most frequent (31.1%, *n* = 1565) response of students was that their mother's highest level of completed education was a bachelor's degree. Another 19% (*n* = 956) indicated that their mother's highest level of education was some college, 17.8% (*n* = 897) indicated that an associate's degree from a 2-year college was their mother's highest completed education, and 12.5% (*n* = 628) responded that a bachelor's degree was their mother's highest level of education. Less than 10% of students responded that their mother's highest level of education was some high school (*n* = 400), a graduate degree (*n* = 288), elementary school or less (*n* = 140), I don't know (*n* = 93), and some graduate school (*n* = 73).

The majority of students indicated that they had taken six or fewer math (78.3%, *n* = 4,026) and four or fewer science (69.1%, *n* = 3551) courses, placing them in the "low math" and "low science" categories, respectively. More than 20% of students indicated that they had taken seven to 12 math courses (21.2%, *n* = 1091) and five to eight science courses (29.4%, *n* = 1509), placing them in the "medium math" and "medium science" categories, respectively. Less than 2% of students responded that they had taken 13–18 math courses (0.4%, n = 23) and 9–12 science courses (1.6%, n = 80), placing them in the "high math" and "high science" categories, respectively.

College/enrollment characteristics. The vast majority (95%, n = 4,055) of the students were attending college within 50 miles of their permanent home, whereas 8.4% (n = 393) were attending college between 51 and 100 miles from their home, 3.9% (n = 184) lived between 101 and 500 miles from their current college, and 1.2% (n = 58) were attending college more than 500 miles from their permanent home. The majority (69.9%, n = 3,277) of the students were enrolled at their current college on a full-time basis, leaving 30.1% (n = 1,414) who indicated that they were enrolled part time. An overwhelming majority (85%, n = 3,986) of students indicated that this was not their first semester in college, leaving 15% (n = 705) who indicated that this was their first semester to ever attend college.

Just over half (57.6%, n = 2,707) of the students indicated that they intended to transfer to a 4-year institution, and 42.4% (n = 1,992) responded that they did not intend to transfer to a 4-year institution. The majority (77.8%, n = 3,639) of students in the study did not have STEM aspirations, leaving 22.2% (n = 1,040) who indicated that they did have STEM aspirations. Of the students with STEM aspirations, 43.5% (n = 443) intended to major in health-related fields, 13.2% (n = 134) were planning to major in engineering, 11.5% (n = 117) intended to major in another STEM-related field, and 11.2% (n = 114) were planning to pursue a degree in biology. Few students indicated that they intended to major in computer science (n = 91), technology (n = 72), physical science (n = 39), forestry (n = 6), and military science (n = 2).

Nearly 1,400 (n = 1,396) students indicated that they would like to attain at least a bachelor's degree and maybe more, 23.4% (n = 1,142) hoped to complete a master's degree, 15% (n = 733) intended to complete a bachelor's degree as their highest level of education, 14.6% (n = 710) wanted to complete a doctoral degree (Ph.D., Ed.D., or J.D.), and10.5% (n = 513) planned to complete an associate's degree. Fewer than 300 (n = 298) students indicated that they intended to complete a medical degree (M.D., D.D.S., or D.V.M.), complete a vocational certificate (n = 72), or take classes, but not complete a degree (n = 10). More than half (51.3%, n = 2,564) of the students indicated they had some concern about finances, 24.7% (n = 1,235) had major financial concerns, and 24% (n = 1,202) have no concern for finances.

Engagement. In terms of peer engagement, 32.1% (n = 1,598) of the students indicated that they had used/received peer engagement and found it somewhat helpful, 29.7% (n = 1,474) had used/received peer engagement and found it not helpful, 28% (n = 1393) had not used/received peer engagement, and 10.2% (n = 508) had used/received peer engagement and found it very helpful. Nearly half (46.9%, n = 2,321) of the students indicated that they had not used/received encouragement or assistance from faculty or staff members, 38.3% (n = 1,897) had used/received faculty/staff encouragement/assistance and found it not helpful, 12.1% (n = 602) had used/received encouragement or assistance from a staff or faculty member and found it somewhat helpful, and only 2.7% (n = 135) found faculty/staff encouragement/assistance very helpful. A total of 1,051 students disagreed that transfer engagement was helpful, 18.8% (n = 884) slightly disagreed that transfer engagement was helpful to them, and 15.8% (n = 743) slightly agreed that transfer engagement was helpful. Less than 15% of students indicated that they strongly disagreed (n

= 699), agreed (*n* = 627), strongly agreed (*n* = 381), and neither agreed nor disagreed (*n* = 316) that they found transfer engagement to be helpful. The largest percentage (36.4%) of students engaged with faculty on coursework a few times per semester (*n* = 1,711), 23.8% (*n* = 1,116) engaged with faculty once a month, 19.9% (*n* = 936) interacted with faculty regarding coursework several times per month, 10.8% (*n* = 509) never engaged with faculty, and 9.1% (*n* = 429) engaged with faculty on coursework several times per week.

Intention to Transfer

The total number of Iowa community college respondents to the SSSL survey who indicated that they intended to transfer to a 4-year institution was 2,707 (57.6%). Background demographic data on the SSSL respondents was analyzed in three subcategories: background demographics, collegiate information, and engagement.

Background demographics. The majority of students (70.2%, *n* = 1,884) who intended to transfer to a 4-year institution were female, leaving 29.8% (*n* = 799) who were male. More than half (52.6%, *n* = 1,409) of students were traditional age (18–24 years of age), 33.6% (*n* = 901) were 25–39 years of age, and 13.8% (*n* = 371) were at least 40 years old. A large majority (83.9%, *n* = 2259) of students identified as White/Caucasian, and 5% (*n* = 135) responded as being African American/Black. No other ethnicity accounted for more than 4% of the sample: two or more races, (*n* = 99), Hispanic (*n* = 72), Asian (*n* = 69), unknown (*n* = 29), American Indian/Alaskan Native (*n* = 24), and Native Hawaiian or Pacific Islander (*n* = 5). Of the students who indicated they intended to transfer, 2,505 indicated that English was their native language, whereas 6.5% indicated that their native language was something other than English (*n* = 175). More than half (53.2%, *n* = 1426) of the students indicated that they were single or had never been married; 23.5% (*n* = 632) reported that they were currently married; 13.4% (*n* = 358) were living together but not married; and 9.9% (*n* = 265) were divorced, separated, or widowed.

Nearly two-thirds (64%, *n* = 1,731) of students responded that they were currently working off campus, 17.4% (*n* = 469) were unemployed but looking for work, 11.6% (*n* = 314) were not working and not looking for work, and 7% (*n* = 189) were currently working on campus. Of those students who were currently working, 37% (*n* = 706) were working more than 30 hours per week, 24.4% (*n* = 467) were working 21–30 hours per week, 16.6% (*n* = 319) were working between 16 and 20 hours per week, 12.5% (*n* = 238) were working 10 or fewer hours per week, and 9.5% (*n* = 181) were work 11–15 hours per week.

More than one in three (34.6%, *n* = 931) students reported that the highest level of education completed by their father was high school graduate, 17.4% (*n* = 467) indicated that their father had completed some college, 12.6% (*n* = 340) reported that their father completed a bachelor's degree, and 12% (*n* = 324) responded that their father's highest completed level of education was an associate's degree from a 2-year college. Less than 10% of students responded that their father had completed some high school (*n* = 237), a graduate degree (*n* = 174), elementary school or less (*n* = 73), or some graduate school (*n* = 20) as their highest level of education, and 4.7% indicated that they didn't know the highest level of education completed by their father. Over one in four students (28.3%, *n* = 759) reported that the highest level of education completed by their mother was high school graduate, 19.6% (*n* = 526) indicated that some college was the highest degree completed by their mother, 19.1% (*n* = 513) reported that their mother had completed an associate's degree from a 2-year college as her highest education, and 14.5% (*n* = 387) responded that their mother's highest completed education was a bachelor's degree. Fewer than 200 students indicated that their mother's highest completed education was some high school (*n* = 172), a graduate degree (*n* = 169), elementary school or less (*n* = 75), or some graduate school (*n* = 40), and 39 students indicated that they did not know the highest education completed by their mother.

The majority of students indicated that they had taken six or fewer math (72.7%, *n* = 1,968) and four or fewer science (62.1%, *n* = 1682) courses, placing them in the "low math" and "low science" categories, respectively. More than one in four students indicated that they had taken between seven and 12 math courses (26.8%, *n* = 725) and five to eight science courses (36.1%, *n* = 978), placing them in the "medium math" and "medium science" categories, respectively. Less than 2% of students responded that they had taken 13–18 math courses (0.5%, *n* = 14) and 9–12 science courses (1.8%, *n* = 47), placing them in the "high math" and "high science" categories, respectively.

College/enrollment characteristics. Of the students who intended to transfer to a 4-year institution, 86.3% (*n* = 2,319) were attending college within 50 miles of their permanent home, 7.6% (*n* = 204) were living within 51–100 miles of their current college, 4.5% (*n* = 121) were attending college between 101 and 500 miles from their home, and 1.6% (*n* = 42) were attending college more than 500 miles from their permanent home. Nearly three out of four students (73.3%, *n* = 1,974) were enrolled at their current college on a full-time basis, leaving 26.7% (*n* = 718) who were enrolled part time. An overwhelming majority of students (83.7%, *n* = 2,251) indicated that this was not their first semester in college, and 16.3% (*n* = 439) responded that this was the first time they had attended any college.

More than two-thirds of the respondents (67.2%, *n* = 1,807) indicated that they did not have STEM aspirations, and 32.8% (*n* = 883) indicated that they did intend to major in a

STEM-related field. Of the students with STEM aspirations, 42.1% (*n* = 360) were planning to major in a health-related field, 13.9% (*n* = 119) intended to pursue a degree in engineering, 12% (*n* = 103) were planning to major in biology, and 11.8% (*n* = 101) were planning to complete a degree in another STEM-related field. Fewer than 100 students responded that they were planning to major in computer science (*n* = 80), technology (*n* = 52), physical science (*n* = 36), forestry (*n* = 4), or military science (*n* = 1). Nearly 30% of students (29.5% and 29.4%, respectively) indicated that they intended to complete a master's degree (*n* = 796) or at least a bachelor's degree (*n* = 794). An additional 21.2% (*n* = 574) were planning to complete a doctoral degree, and 11% (*n* = 297) intended to complete a bachelor's degree. Fewer than 200 students intended to complete a medical degree (*n* = 197), associate's degree (*n* = 37), or vocational degree (*n* = 3) as their highest academic degree. Only 0.1% (*n* = 2) indicated that they were not planning to complete a degree. More than half (51.9%, *n* = 1,400) of the students indicated that they had some concern about finances, 27.1% (*n* = 732) responded that they had major concerns about finances, and 21% (*n* = 567) reported that they had no financial concerns about financing their education.

Engagement. Of the students who intended to transfer to a 4-year institution, 32.1% (*n* = 842) of the students indicated that they had used or received peer engagement and that it was somewhat helpful, 29.1% (*n* = 765) responded that the peer engagement that they had used/received was not helpful, 28.4% (*n* = 744) reported that they had not used or received peer engagement, and 10.4% (*n* = 274) indicated that peer engagement had been very helpful. Of the students responding, 522 reported that they agreed that they had used transfer engagement, 19.3% (*n* = 516) slightly agreed, 17.1% (*n* = 456) slightly disagreed, 15.9% (*n* = 424) disagreed, 12.1% (*n* = 324) strongly agreed, 11% (*n* = 293) strongly disagreed, and

5% (*n* = 134) neither agreed nor disagreed that they had used transfer engagement. Nearly half the students (46.4%, *n* = 1,220) had not used/received faculty or staff encouragement or assistance, 38.9% (*n* = 1,022) had used or received faculty/staff encouragement/assistance, but had not found helpful, 11.9% (*n* = 312) had used/received faculty/staff encouragement/ assistance and found it somewhat helpful, and 2.8% (*n* = 73) had used or received encouragement or assistance from staff or faculty members and found it very helpful. More than one in three students (35.9%, *n* = 959) indicated that they engaged with faculty on coursework a few times per semester, 23.7% (*n* = 635) reported that they engaged with faculty on coursework once a month, 20.2% (*n* = 540) engaged with faculty several times per month, 10.4% (*n* = 279) responded that they never engaged with faculty about their coursework, and 9.8% (*n* = 261) engaged with faculty on coursework several times per week.

STEM Aspirations

The total number of Iowa community college respondents to the SSSL survey who indicated that they had STEM aspirations was 1,040 (22.2%). Background demographic data on the SSSL respondents was analyzed in three subcategories: background demographics, collegiate information, and engagement.

Background demographics. Nearly two-thirds (62.1%, *n* = 638) of students with STEM aspirations were female, leaving 37.9% (*n* = 390) who were male. Students 18–24 years of age accounted for nearly half (46.6%, *n* = 479) of the students in the STEM aspirations group, 37.1% (*n* = 381) were between the ages of 25 and 39, and 16.3% (*n* = 167) reported that they are at least 40 years old. The overwhelming majority (82.7%, *n* = 853) of students in the STEM aspirations group were white/Caucasian, and 5.1% (*n* = 53) of students identified as Black/African American. No other ethnicity accounted for more than

3.5% of the sample: 36 students were two or more races, 34 were Asian, 31 were Hispanic, nine were American Indian/Alaskan Native, and two were Native Hawaiian/Pacific Islander. Thirteen (1.3%) students indicated that their ethnicity was unknown. An overwhelming majority 90.7% (*n* = 931) of students reported that their native language was English, leaving 9.3% (*n* = 96) who indicated that their native language is not English. Nearly half (49.6%, *n* = 509) of students with STEM aspirations were single and had never been married; 26.4% (*n* = 271) were currently married; 12.5% (*n* = 129) were living together but were not married; and 11.5% (*n* = 118) were divorced, separated, or widowed.

Students working off campus accounted for 60.5% (*n* = 629) of the current employment status of STEM aspirants, whereas 17.4% were currently unemployed but looking for work, 11.6% were not working and not currently looking for work, and 7% were working on campus. Of the students who were currently working, 36.1% (*n* = 252) were working more than 30 hours per week, 22.6% (*n* = 158) were working 21–30 hours per week, 17.9% (*n* = 125) were working between 16 and 20 hours per week, 13.6% (*n* = 95) were work 10 or fewer hours per week, and 9.8% (*n* = 68) were working 11–15 hours per week.

Of the students with STEM aspirations, more than one in three (33.9%, *n* = 351) indicated that the highest level of education completed by their father was a high school graduate, 18.1% (*n* = 187) indicated that their father's highest level of education was some college, 11.8% (*n* = 122) reported that their father had completed a bachelor's degree as his highest completed education, and 11.2% (*n* = 116) responded that their father's highest completed education was an associate's degree. No other level of education accounted for more than 10% of the sample: some high school (*n* = 102), graduate degree (*n* = 69), elementary school or less (*n* = 34), and some graduate school (*n* = 13). Forty (3.9%) of students indicated that they didn't know their father's highest level of completed education. Over one in four (28.1%, *n* = 289) students with STEM aspirations indicated that their mother's highest level of completed education was high school graduate, 19.2% (*n* = 197) responded that their mother had completed some college as her highest level of education, 18.1% (*n* = 186) reported that their mother's highest level of education was an associate's degree, and 14.1% (*n* = 145) indicated that their mother had completed a bachelor's degree as her highest level of education. No other level of education accounted for more than 7% of the STEM aspirations sample: some high school (*n* = 71), graduate degree (*n* = 69), elementary school or less (*n* = 40), and some graduate school (*n* = 20). Eleven (1.1%) students indicated that they did not know their mother's highest level of completed education.

The majority of students with STEM aspirations indicated that they had taken six or fewer math courses (63.7%, *n* = 663) and four or fewer science courses (51.7%, *n* = 538), placing them in the "low math" and "low science" categories, respectively. More than one in three students indicated that they had taken seven to 12 math courses (35%, *n* = 364) and five to eight science courses (44.8%, *n* = 466), placing them in the "medium math" and "medium science" categories, respectively. Less than 4% of students responded that they had taken 13–18 math courses (1.3%, *n* = 13) and nine to 12 science courses (3.5%, *n* = 36), placing them into the "high math" and "high science" categories, respectively.

College/enrollment characteristics. The vast majority of students (85.6%, *n* = 880) were attending college 50 miles or less from their permanent home, 8.9% (*n* = 91) were living 51–100 miles from their current college, 4% (*n* = 41) were attending college between

101 and 500 miles from their permanent home, and 1.5% (*n* = 16) were living more than 500 miles from their college. Nearly three-fourths of students (72.7%, *n* = 748) with STEM aspirations were attending college full time, and 27.3% (*n* = 281) were attending on a part-time basis. The 881 students who had attended college prior to the Fall 2012 semester accounted for 85.5% of STEM aspirants; 14.5% (*n* = 149) indicated that this was their first semester enrolled at any college. Of the 1,040 students with STEM aspirations, 43.8% (*n* = 433) intended to major in a health-related field, 13.3% (*n* = 131) were planning to pursue a degree in engineering, 11.4% (*n* = 113) intended to pursue a career in biology, and 10.9% (*n* = 108) were planning to major in another STEM field. Fewer than 100 students each planned to major in computer science (*n* = 89), technology (*n* = 68), physical science (*n* = 39), forestry (*n* = 6), or military science (*n* = 2). Almost equal numbers of students with STEM aspirations intended to complete at least a bachelor's degree and maybe more (25.8%, *n* = 268), hoped to complete a doctoral degree (24.9%, *n* = 258), or were planning to complete a master's degree (24.5%, *n* = 255) as their highest degree. In addition, 11% (*n* = 114) intended to complete a medical degree and 9.9% (*n* = 103) were planning to complete a bachelor's degree as their highest degree. Fewer than 50 students indicated that they were planning to complete an associate's degree (*n* = 31) or a vocational certificate (*n* = 8), and only one student in the STEM aspirations group indicated that he or she was taking classes but did not intend to complete a degree or certificate. Of the students with STEM aspirations, more than half (51%, *n* = 529) indicated that they had some concern about finances, 28.3% (*n* = 294) responded that they had major financial concerns, and 20.7% (*n* = 215) reported that they had no concerns about financing their education.

Engagement. Of the students in the STEM aspirations group, more than one-third (35.3%, *n* = 357) responded that they had used or received peer engagement and found it somewhat helpful, 28.2% (*n* = 286) had used or received peer engagement and did not find it to be helpful, 25.1% (*n* = 254) indicated that they had not used or received peer engagement, and 11.4% (*n* = 115) had used or received peer engagement and found it very helpful. Of students with STEM aspirations, 18.6% (*n* = 191 indicated that they slightly agreed that they had used transfer engagement, 18.5% (*n* = 190) slightly disagreed that they had used transfer engagement, 17.1% (*n* = 175) disagreed about their use of transfer engagement, 16.9% (*n* = 173) reported that they agreed that they utilized transfer engagement, 12.2% (*n* = 125) strongly disagreed that they had used transfer engagement, and 11.7% (*n* = 120) strongly agreed on their utilization of transfer engagement. Fifty students indicated that they neither agreed nor disagreed about their use of transfer engagement.

Of students with STEM aspirations, 43.5% (*n* = 441) indicated that they had not used nor received encouragement or assistance from staff or faculty members, 41.6% (*n* = 421) indicated that they had used or received encouragement/assistance from staff/faculty but found it unhelpful, 11.3% (*n* = 11.9) responded that they had used or received encouragement or assistance from faculty members or college staff and found it to be somewhat helpful, and 3.6% (*n* = 36) indicated that the encouragement or assistance that they received from staff or faculty members was very helpful. More than one in three students (35.5%, *n* = 364) indicated that they engaged with faculty regarding coursework a few times per semester, 24.7% (*n* = 253) reported that they engaged with faculty on coursework once a month, 20.8% (*n* = 213) responded that they engaged with faculty to discuss or review coursework several times per month, and 10.9% (*n* = 111) indicated that they engaged with faculty regarding coursework several times per week. Of the STEM aspirants, 8.1% (*n* = 83) indicated that they never engaged with faculty about coursework.

Descriptive Summary

There are a number of similarities between the three student groups: all students, intention to transfer, and STEM aspirations. The majority of students in all three groups were female, between 18 and 24 years of age, and White/Caucasian. More than 90% of students in each of the three groups indicated that English was their native language. Nearly half of the students in all three groups reported that they were single and had never been married. The majority of students in all three groups indicated that they were currently working off campus, and those students who were currently working indicated that they were working more than 30 hours per week. High school graduate was the highest level of education completed by the highest percentage of both mothers and fathers of students in all three groups. More than half of the students in each group indicated that they had completed from zero to six math courses and zero to four sciences courses, placing them into the low math and low science categories, respectively.

More than 85% of students in each group were living 50 miles or less from the college that they were currently attending. The vast majority of students in all three groups were attending college on a full-time basis and indicated that this was not their first semester attending college. The majority of students responded that they intended to transfer to a 4-year college or university. The majority of all students and those in the intention to transfer group did not have STEM aspirations. Of the students who had STEM aspirations, more than 40% intended to major in a health-related field. The next most likely field for students to transfer into was engineering, followed by biology. All students, students with transfer intentions, and students with STEM aspirations all indicated at roughly the same rate (52%, 58.9%, and 50.3%, respectively) that they intended to complete at least a bachelor's degree and maybe more or a master's degree. The majority of all students and those in the STEM aspirations group indicated that they intended to complete at least a bachelor's degree as their highest desired degree. More than half of the students in all three groups indicated that they were somewhat concerned about financing their college education.

More than 30% of students in each group indicated that they used or received peer engagement and found it somewhat helpful. The largest proportion of all students indicated that they disagreed that they had used transfer engagement, whereas the largest proportion of students in the intention to transfer group reported that they agreed that they utilized transfer engagement, and the largest proportion of STEM aspirations students responded that they slightly agreed that they used transfer engagement. The majority of students in all three groups indicated that they had not used or received encouragement or assistance from staff or faculty members. More than 35% of students in each of the three groups indicated that they engaged with faculty on coursework a few times per semester.

There was little deviation between the demographic and engagement variables associated with the three groups of students. Students in each group appear to have similar demographic backgrounds, educational experiences and goals, and engagement practices.

Factor Analysis

Exploratory and confirmatory factor analyses were conducted to establish the constructs surrounding engagement for community college students. The exploratory factor analysis was run using IBM SPSS 20.0, and the confirmatory factor analysis was analyzed using AMOS Graphics 20.0. Both the exploratory and confirmatory factor analyses were conducted using the SSSL dataset of 5,140 students.

Exploratory Factor Analysis

Based on a review of the literature, 19 observed variables were identified as potential engagement items. Before conducting the exploratory factor analysis, the necessary assumptions were checked and met. The sample size to variable ratio of "30 cases for the first observed variable and 10 cases for each additional observed variable" required that the sample size consist of at least 210 cases (Urdan, 2010). The sample size of 5,140 cases was more than adequate to conduct the exploratory factor analysis. The factor analysis is of an exploratory nature, therefore assumptions of linearity and normality are not enforced (Mertler & Vannatta, 2010; Tabachnick & Fidell, 2007). The absence of multicolinearity was tested using a linear regression analysis, and variables with a variance inflation factor less than 3.0 were accepted (Mertler & Vannatta, 2010).

Constructs with eigenvalues greater than 1.0 were accepted as constructs of engagement. Items with loadings greater than .50 were accepted as adequate elements of the construct (Mertler & Vannatta, 2010). The exploratory factor analysis using varimax rotation produced four engagement constructs with eigenvalues greater than 1.0. The exploratory factor analysis also revealed that one variable "How helpful was the encouragement or advice you received from the following: professor or teacher's assistant for this class" did not load into any of the four engagement constructs. The reliability of the engagement constructs was analyzed using reliability analysis. Constructs producing a Cronbach's alpha greater or equal to .70 were accepted (Mertler & Vannatta, 2010; Tabachnick & Fidell, 2007; Urdan, 2010).

Transfer Engagement. The Transfer Engagement construct produced an eigenvalue of 5.354, while explaining 28.2% of the variance. The results of the exploratory factor analysis for the Transfer Engagement construct are displayed in Table 4.2 and in Figure 4.1. The items in the construct reflected students' feelings on their use of engagement with advisors or counselors at the community college and, specifically, about the assistance those advisors/counselors had provided in the transfer process. The variables were analyzed using scores from a 7-point Likert-style scale ranging from 1 (*neither agree nor disagree*) to 7 (*strongly agree*). The means of the variables in the construct ranged from 3.35 to 4.91. All items of the construct produced loadings greater than .660: Question 38_1 (I consulted with academic advisors/counselor regarding transfer, .884), Question 38_5 (I discussed my plans for transferring to a 4-year college or university with an academic advisor/counselor, .840), Question 38_2 (Information received from academic advisors/counselors was helpful in the transfer process, .831), Question 38_6 (Advisors/counselors identified courses needed to

Table 4.2

Exploratory Factor Analysis: Transfer Engagement (α = .884)

Variables	Factor loading
I consulted with academic advisors/counselor regarding transfer	.844
I discussed my plans for transferring to a 4-year college or university with an academic advisor/counselor	.840
Information received from academic advisors/counselors was helpful in the transfer process	.831
Advisors/counselors identified courses needed to meet the general education/major requirements of a 4-year college or university I was interested in attending	.822
I talked with an advisor/counselor about courses to take, requirements and education plans	.687
I met with academic advisors/counselors on a regular basis	.664

Note. Variables scored on a 7-point Likert-type scale: 1 = Strongly disagree, 2 = Disagree, 3 = Slightly disagree, 4 = Neither agree nor disagree, 5 = Slightly agree, 6 = Agree, 7 = Strongly agree.

meet the general education/major requirements of a 4-year college or university I was interested in attending, .822), Question 38_4 (I talked with an advisor/counselor about courses to take, requirements and education plans, .687), and Question 38_3 (I met with academic advisors/counselors on a regular basis, .664). The reliability analysis revealed that the Transfer Engagement construct produced an alpha reliability coefficient (Cronbach's α = .884) that is considered to be good. The reliability analysis also revealed that the alpha reliability would not be improved if any of the items were removed from the construct.

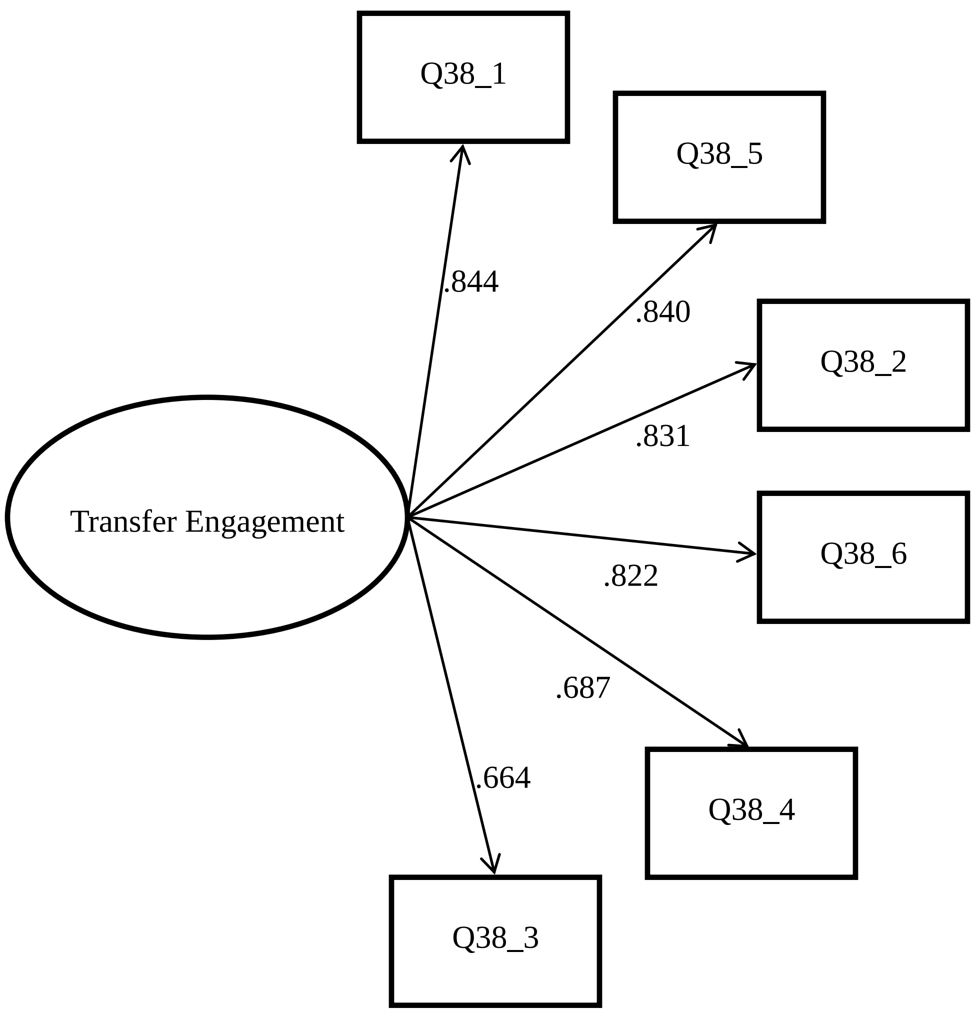

Figure 4.1. Exploratory factor analysis: Transfer Engagement.

Faculty Engagement on Coursework. The results of the exploratory factor analysis for the Faculty Engagement on Coursework construct are displayed in Table 4.3 and Figure 4.2. The Faculty Engagement on Coursework construct produced an eigenvalue of 2.925, while explaining 15.4% of the variance. The variables in the construct reflected the frequency with which students engaged with their professors on material related to their coursework. The variables were analyzed as scores from a 5-point Likert-style scale ranging from 1 (*never or very rarely*) to 5 (*several times a week*). The variables had means that ranged from 2.19 to 2.79. All variables in the construct produced loadings greater than .770: Question 40_2 (felt comfortable approaching faculty outside of class, .834), Question 40_6 (asked my instructor for comments and criticisms about my work, .816), Question 40_5 (discussed career plans and ambitions with a faculty member, .807), and Question 40_1 (visited faculty and sought their advice on class projects such as writing assignments and research papers, .776). The alpha reliability coefficient (Cronbach's α = .854) produced through the reliability analysis is considered to be good. The reliability analysis also revealed that the alpha reliability would not be improved if any of the items were removed from the construct.

Table 4.3

Exploratory Factor Analysis: Faculty Engagement on Coursework (α = .854)

Variable	Factor loading
Felt comfortable approaching faculty outside class	.834
Asked my instructor for comments and criticisms about my work	.816
Discussed career plans and ambitions with a faculty member	.807
Visited faculty and sought their advice on class projects such as writing assignments and papers	.776

Note. Variables scored on a 5-point Likert-type scale, 1 = Never or very rarely, 2 = A few times per semester, 3 = About once a month, 4 = Several times a month, 5 = Several times a week.

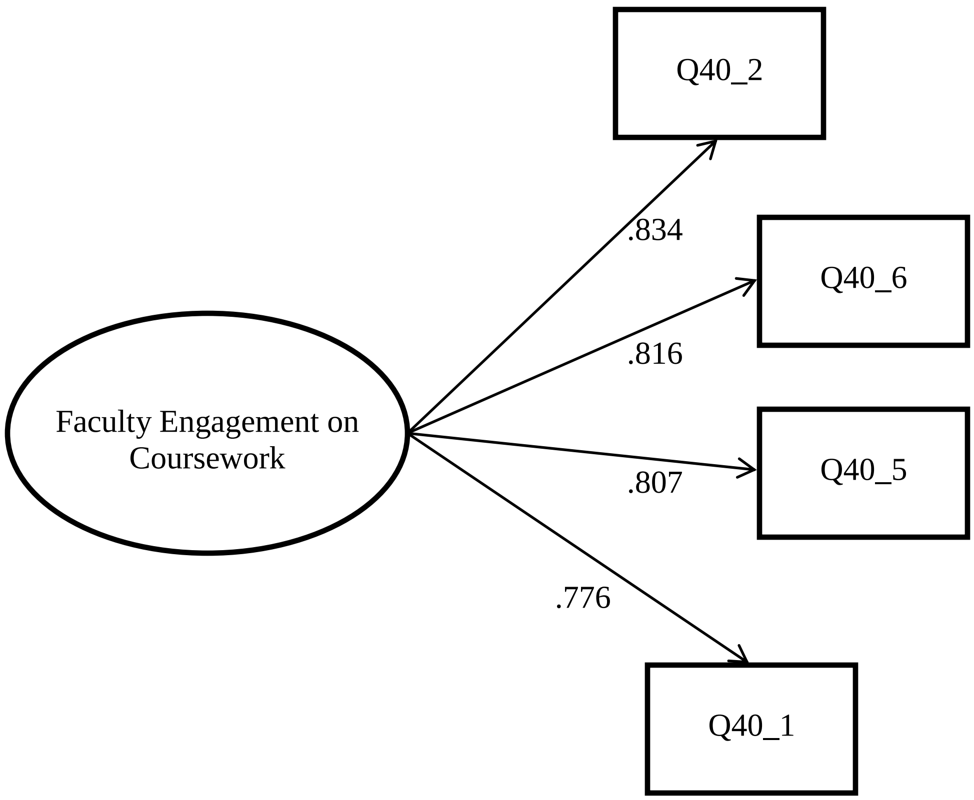

Figure 4.2. Exploratory factor analysis: Faculty Engagement on Coursework.

Faculty/Staff Encouragement/Assistance. The Faculty/Staff Encouragement/ Assistance construct produced an eigenvalue of 1.895, while explaining 9.97% of the variance. The results of the exploratory factor analysis for the construct are displayed in Table 4.4 and Figure 4.3. The construct items reflected the helpfulness of encouragement or advice from staff and faculty members at the community college. The variables were analyzed as scores from a 4-point Likert-style scale ranging from 1 (*did not use/receive, not applicable*) to 4 (*used/received, very helpful*). The means of the variables ranged from 1.13 to 1.88. All items of the construct produced loadings greater than .530: Question 15_9 (academic dean, .773), Question 15_10 (another faculty member, .714), Question 15_7 (advisor, .709), Question 15_2 (fellow resident or resident assistant, .577), and Question

Table 4.4

Exploratory Factor Analysis: Faculty/Staff Encouragement or Assistance (α = .734)

Variable	Factor loading
Encouragement/assistance from an academic dean	.773
Encouragement/assistance from another faculty member	.714
Encouragement/assistance from an advisor	.709
Encouragement/assistance from a fellow resident or resident assistant	.577
Encouragement/assistance from a staff person or administrator	.536

Note. Variables scored on a 4-point Likert-type scale, 1 = Did not use/receive, not applicable, 2 = Used/received, not helpful, 3 = Used/received, somewhat helpful, 4 = Used/received, very helpful.

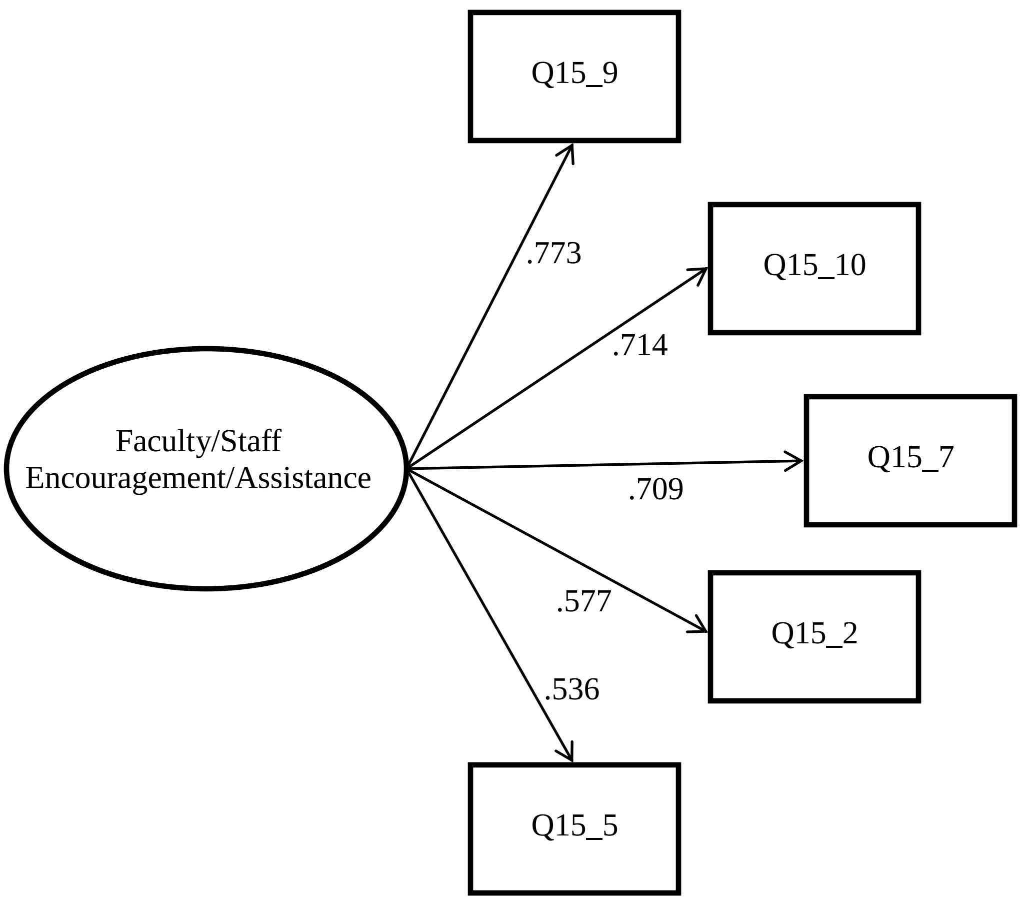

Figure 4.3. Exploratory factor analysis: Faculty/Staff Encouragement/Assistance.

15_5 (staff person or administrator, .536). The reliability analysis revealed that the Faculty/Staff Encouragement/Assistance construct produced an acceptable alpha reliability coefficient (Cronbach's α = .734). The reliability analysis also revealed that the alpha reliability would not be improved if any of the items were removed from the construct.

Peer Engagement. The results of the exploratory factor analysis for the Peer Engagement construct peer engagement are displayed in Table 4.5 and Figure 4.4. The construct produced an eigenvalue of 1.158 and explained 6.1% of the variance. The variables in the construct reflected usefulness/helpfulness of encouragement, advice, and assistance from their peers at the community college. The variables were analyzed as scores from a 4-point Likert-style scale ranging from 1 (*did not use/receive*, *not applicable*) to 4 (*used/received, very helpful*). The items had means that ranged from 1.61 to 2.41. All variables in the construct produced loadings of at least .500: Question 15_3 (fellow classmate, .836), Question 14_10 (studied with other students in the class, .801), and Question 15_4 (upper-class student who had taken the class, .500). The alpha reliability coefficient (Cronbach's α = .691) produced through the reliability analysis is considered to be acceptable. The reliability analysis revealed that, if Question 15_4 (upper-class student who had taken the class) were removed from the construct, the alpha reliability coefficient would increase (Cronbach's α = .703).

The exploratory factor analysis produced four engagement constructs: Transfer Engagement (Cronbach's α = .884), Faculty Engagement on Coursework (Cronbach's α = .854), Faculty/Staff Encouragement/Assistance (Cronbach's α = .734), and Peer Engagement (Cronbach's α = .691). The constructs were further analyzed using confirmatory factor analysis to establish model fit.

Table 4.5

Exploratory Factor Analysis: Peer Engagement (α = .691)

Variable	Factor Loading
Encouragement or assistance from fellow classmate	.836
Studied with other students in the class	.801
Encouragement or assistance from upper-class student who had taken the class	.500

Note. Variables scored on a 4-point Likert-type scale, 1 = Did not use/receive, not applicable, 2 = Used/received, not helpful, 3 = Used/received, somewhat helpful, 4 = Used/received, very helpful.

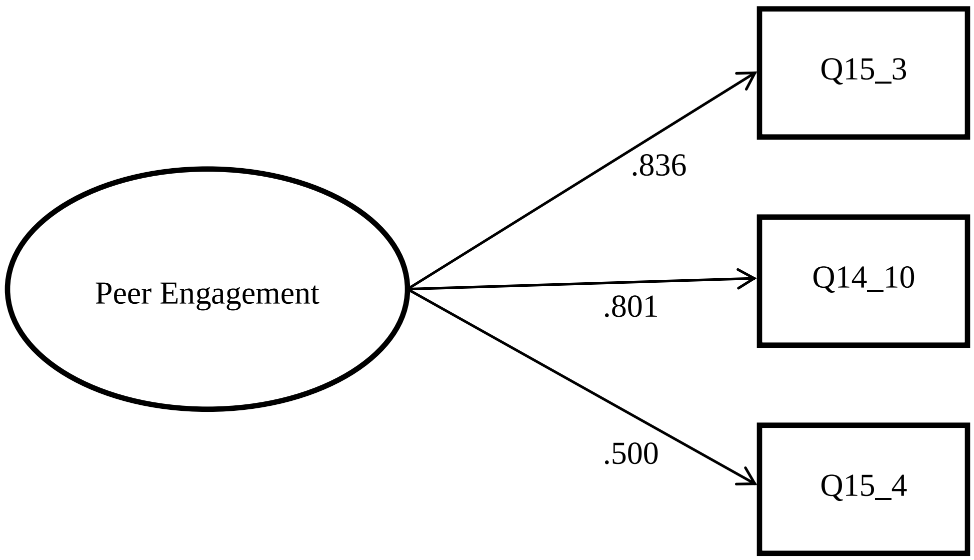

Figure 4.4. Exploratory factor analysis: Peer Engagement.

Confirmatory Factor Analysis

To determine if the results of the exploratory factor analysis were a true fit for the community college engagement model, a confirmatory factor analysis was conducted. IBM AMOS 20.0 was utilized to conduct the confirmatory factor analysis. Missing data is impermissible in conducting the confirmatory factor analysis with the AMOS software, therefore the FIML imputation method was used to replace missing values with imputed data.

The 18 observed variables that were loaded into the four engagement constructs were entered into the confirmatory factor analysis.

Due to the large sample size, the model fit was analyzed based on a number of measures of analysis: Chi square (χ^2), CMIN/*df* (χ^2/df), CFI, RMSEA, GFI, and significance (*p*). There are numerous suggestions as to the recommended thresholds for the goodness-of-fit indicators, but this study focused on χ^2/df less than 5, CFI and GFI greater than 0.95, RMSEA less than 0.06, and significance less than or equal to 0.01 (Hair, Black, Babin, Anderson, & Tatham, 2006; Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1998; Tabachnick & Fidell, 2007).

The proposed model for the confirmatory factor analysis can be found in Figure 4.5. The proposed model consists of four factors: Peer Engagement, Transfer Engagement, Faculty Engagement on Coursework, and Faculty/Staff Encouragement Assistant. The four constructs each consisted of between three and six questions related to the nature of engagement to be measured.

The initial analysis of the proposed student engagement construct revealed two variables with factor loadings below .50, and therefore those variables (Question 15_4 and Question 38_4) were removed. Further analysis revealed that two variables (Question 38_3 and Question 15_9) produced extremely high covariances with other variables in the model. The extreme number of covariances indicated that the variables did not fit properly into one specific construct, suggesting issues with model fit, and therefore, those two variables also were removed from the model. Numerous variations of the model were analyzed and covariances among variables were established to determine the best model fit for the community college student engagement model.

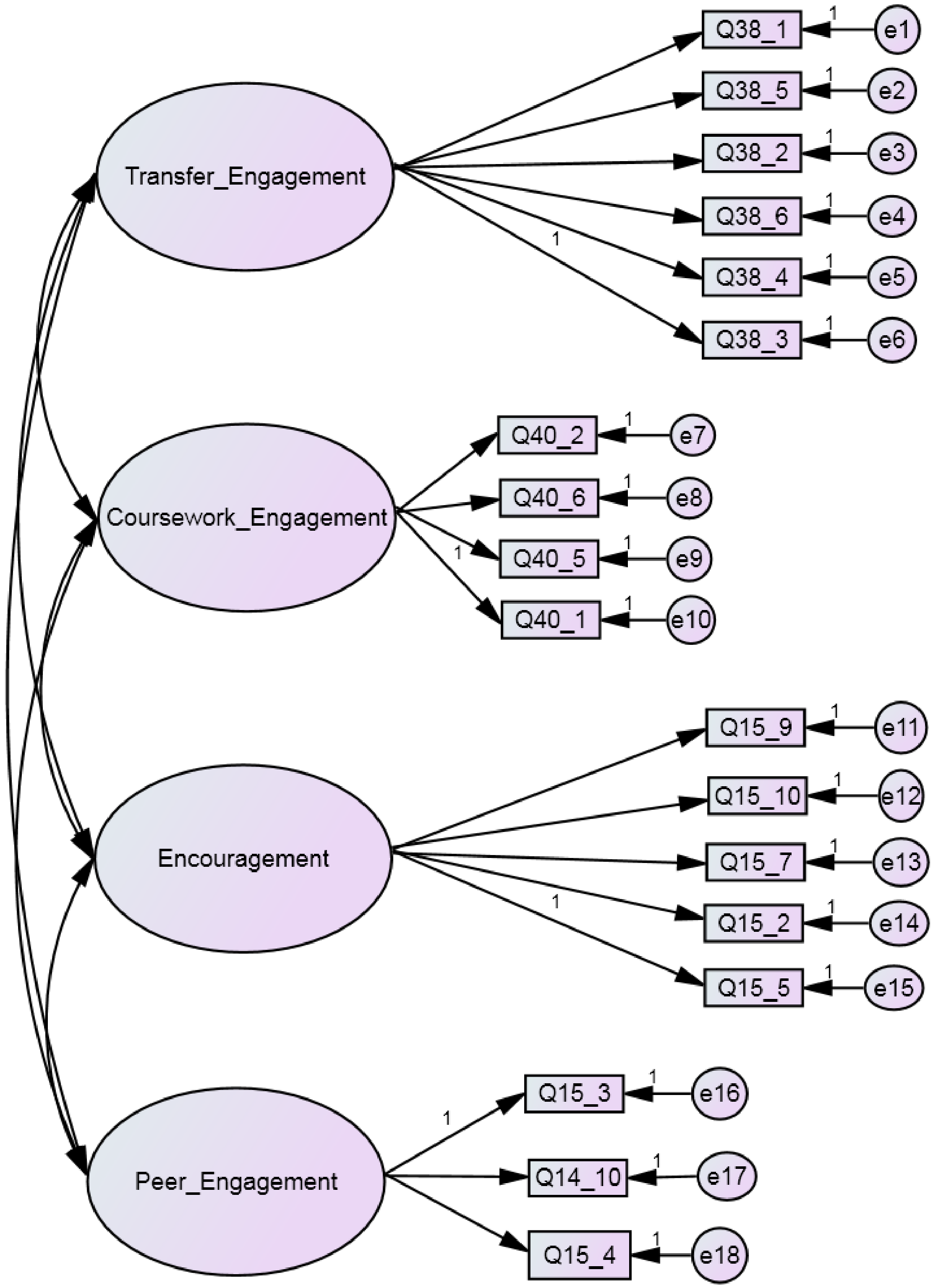

Figure 4.5. Proposed community college student engagement model.

The final results of the confirmatory factor analysis are displayed in Table 4.6 and Table 4.7, and the final community college student engagement model is displayed in Figure 4.6. Items with loadings above .50 were retained in the community college student engagement model (Mertler & Vannatta, 2010). The confirmatory factor analysis produced a final model that had a very good model fit and was accepted based on the standards for this study, χ^2/df = 2.375, CFI = 0.997, GFI = 0.996, RMSEA = 0.016, and p <.001.

Table 4.6

Goodness-of-Fit Indicators

Model	*n*	χ^2	*df*	χ^2/df	CFI	RMSEA	GFI	*p*
Community college student engagement	5140	144.898	61	2.375	0.997	0.016	0.996	<.001

Table 4.7

Confirmatory Factor Analysis: Community College Student Engagement Model

Construct/variable	Factor loading
Transfer engagement	
I discussed my plans for transferring to a 4-year college or university with an academic advisor/counselor	0.77
Advisors/counselors identified courses needed to meet the general education/major requirements of a 4-year college or university I was interested in attending	0.76
Information received from academic advisors/counselors was helpful in the transfer process	0.75
I consulted with academic advisors/counselors regarding transfer	0.70
Faculty engagement on coursework	
Discussed career plans and ambitions with a faculty member	0.79
Felt comfortable approaching faculty outside class	0.74
Asked my instructor for comments and criticisms about my work	0.74
Visited faculty and sought their advice on class projects such as writing assignments and research papers	0.73
Faculty/staff encouragement/assistance	
Encouragement/assistance from staff person or administrator	0.64
Encouragement/assistance from another faculty member	0.63
Encouragement/assistance from advisor	0.62
Encouragement/assistance from fellow resident or resident advisor	0.52
Peer Engagement	
Studied with other students in the class	0.73
Encouragement or advice from fellow classmate	0.72

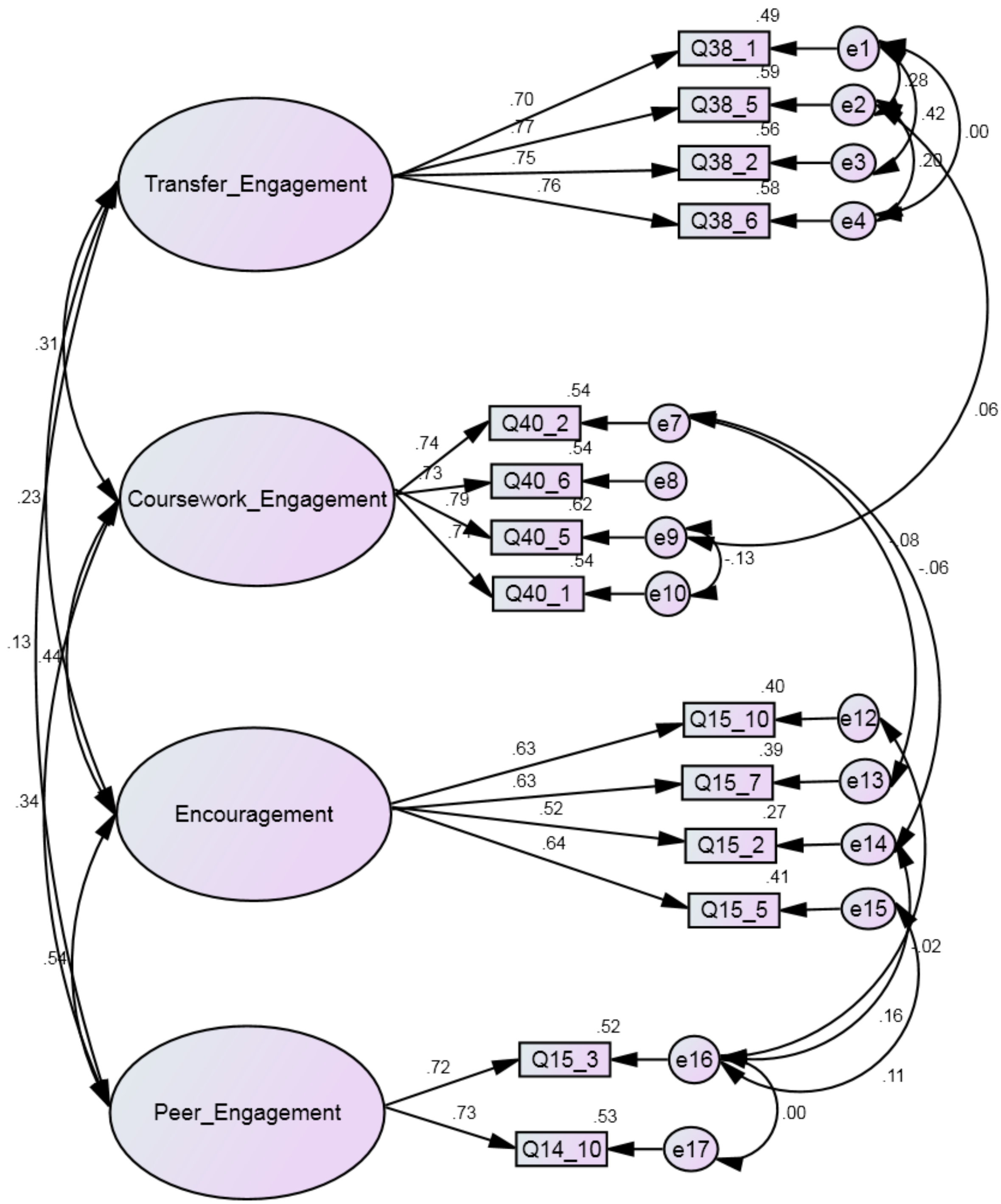

Figure 4.6. Confirmatory factor analysis: community college student engagement model.

The four constructs produced through the exploratory factor analysis and confirmed in the confirmatory factor analysis were utilized to guide the logistic regression analysis. Each construct was entered as a block into the logistic regression analysis along with a specific block for demographic characteristics.

Comparative Analysis

Three types of comparative analyses were used to determine if differences existed between the independent variables associated with students' intention to transfer or students' STEM aspirations: cross-tabulations with Pearson chi-square analysis, independent samples *t*-test, and the Mann-Whitney U test. The type of analysis used was determined by the type of variable (nominal, ordinal, dichotomous, or scale). Nominal and dichotomous variables were analyzed using cross-tabulations and Pearson chi-square tests. Ordinal and scale variables that were normally distributed were analyzed using an independent samples *t*-test, and ordinal and scale variables that violated the assumptions of equality or normality were analyzed using the Mann-Whitney U test (Aron et al., 2005; Mertler & Vannatta, 2010; Morgan et al., 2007; Tabachnick & Fidell, 2007; Urdan, 2010). The effect of each predictor variable was analyzed on both dependent variables (intention to transfer and STEM aspirations).

According to Morgan et al. (2007), nominal variables "have no implied order or value" (p. 37). The nominal variables in this study included: ethnicity, marital status, peer engagement, transfer engagement, faculty/staff encouragement/assistance, and coursework engagement. Morgan et al. also stated, "Dichotomous variables always have only two levels or categories" (p. 37). Gender, native language, enrollment status, and college status are dichotomous variables analyzed in this study. The nominal and dichotomous variables were analyzed with cross-tabulations and a Pearson chi-square test.

Cross-tabulation and the Pearson chi-square tests were the nonparametric tests utilized to analyze the nominal and dichotomous variables. The phi coefficient and Cramer's *V* were utilized to establish statistical significance and examine the strength of significance between the dependent and independent variables. The phi coefficient was utilized for 2 × 2 cross-tabulations (gender, native language, enrollment status, and college status), whereas Cramer's *V* was used for larger cross-tabulations (ethnicity, mother's highest level of completed education, father's highest level of completed education, marital status, peer engagement, transfer engagement, staff/faculty encouragement/assistance, and faculty engagement on coursework (Morgan et al., 2007; Urdan, 2010).

According to Morgan et al. (2007), ordinal variables are "ordered from low to high, such that ranks [can] be assigned" (p. 38). Urdan (2010) noted that ordinal variables do establish rank, but they do not convey the distance between variables (p. 4). Ordinal variables included in this study were: age, level of math completed, level of science completed, financial concerns, distance from home, hours worked, and highest desired degree. According to Morgan et al., there are three assumptions that should not be markedly violated when utilizing an independent samples *t*-test to analyze the difference between two independent groups:

1. The variances of the dependent variable in the population are equal.
2. The dependent variable is normally distributed within each population.
3. The data values are independent of each other (pp. 143–144).

The ordinal variables that did not markedly violate the assumptions of the *t*-test were analyzed using inferential statistics through the use of the independent samples *t*-test, and the variables that violated the assumption of normality were analyzed using the nonparametric Mann-Whitney U test.

The variances of the dependent variable within the population are evaluated through the use of Levene's test for equality of variances. A statistically significant result produced through the Levene's test ($p \leq .05$) indicates that the variances of the dependent variables are significantly different and that equal variances are not assumed (Morgan et al., 2007; Urdan, 2010). Displayed in Table 4.8 are the results of the Levene's test for equality of variances for the dependent variable intention to transfer, which revealed three variables (age, number of hours worked for pay weekly, and concern for finances) that do not violate the assumption of equal variances. Four variables (highest desired degree, level of math completed, level of science completed, and distance of college from permanent home) violated the assumption of equal variances.

Table 4.8

Levene's Test for Equality of Variances: Intention to Transfer

Variable	Assumption	*F*	*p*
Age	Equal variances assumed	1.521	.218
Concern for finances	Equal variances assumed	0.396	.529
Hours worked for pay weekly	Equal variances assumed	1.777	.183
Highest desired degree	Equal variances not assumed	119.730	.001
Level of math completed	Equal variances not assumed	179.290	.001
Level of science completed	Equal variances not assumed	110.200	.001
Distance of college from permanent home	Equal variances not assumed	18.871	.001

Displayed in Table 4.9 are the results of the Levene's test for equality of variances for the dependent variable STEM aspirations, which revealed three variables (age, number of hours worked for pay weekly, and highest desired degree) that did not violate the assumption of equal variances. Four variables (concern for finances, level of math completed, level of science completed, and distance of college from permanent home) violated the assumption of equal variances.

Table 4.9

Levene's Test for Equality of Variances: STEM Aspirations

Variable	Assumption	*F*	*p*
Age	Equal variances assumed	1.911	.167
Concern for finances	Equal variances not assumed	3.921	.048
Hours worked for pay weekly	Equal variances assumed	0.941	.332
Highest desired degree	Equal variances assumed	1.474	.225
Level of math completed	Equal variances not assumed	357.660	.001
Level of science completed	Equal variances not assumed	184.050	.001
Distance of college from permanent home	Equal variances not assumed	3.851	.050

Skewness of the variable is important when establishing normal distribution properties. The traditional guideline for normality is a skewness between –1 and 1 (Aron et al., 2005; Mertler & Vannatta, 2010; Morgan et al., 2007; Tabachnick & Fidell, 2007; Urdan, 2010). Shown in Table 4.10 are the results of the analysis of the skewness of all the ordinal variables, which revealed that four variables (age, concern for finances, hours worked weekly, and highest desired degree) were approximately normal (with skewness between –1 and 1).

The final assumption of the *t*-test that must not be markedly violated is the independence of data. The data of all independent variables in this study are independent of each other indicating that the "scores of one participant are not dependent on scores of the others" (Morgan et al., 2007, p. 147). This study was designed so that students would not be included into both the intention to transfer and the no intention to transfer groups or the STEM aspirations and the no STEM aspirations group. The survey was designed so that there is no relationship between the observations for each student. This indicates that independence exists for all independent variables and two dependent variables, intention to transfer and STEM aspirations.

After reviewing the three assumptions of the independent samples *t*-test for the dependent variable intention to transfer, the results indicated that there were three

Table 4.10

Descriptive Analysis of Ordinal Variables

				Skewness	
Variable	*n*	*M*	*SD*	Statistic	SE
Age	4,683	1.74	0.754	0.470	0.036
Level of math completed	5,140	1.22	0.426	1.517	0.034
Level of science completed	5,140	1.33	0.501	1.117	0.034
Distance of college from permanent home	4,690	1.20	0.559	3.077	0.036
Concern for finances	5,001	2.01	0.698	–0.009	0.035
Hours worked at a job for pay weekly	3,365	3.65	1.398	–0.696	0.042
Highest desired academic degree	4,874	5.30	1.420	–0.100	0.036

variables that did not markedly violate the assumptions. The ordinal variables were inferentially analyzed through the use of the independent samples *t*-test. The variables that were analyzed utilizing the *t*-test were: age, concern for finances, and number of hours worked for pay weekly. When the assumptions of the *t*-test are markedly violated, the nonparametric Mann-Whitney U test is used to analyze differences between the variables. The Mann-Whitney U test was used to analyze the variables level of math completed, level of science completed, distance of college from home, and highest desired degree.

A review of the three assumptions of the independent samples *t*-test for the dependent variable STEM aspirations revealed that three variables existed that did not markedly violate the *t*-test assumptions. The ordinal variables that were inferentially analyzed using the independent samples *t*-test were: age, number of hours worked for pay weekly, and highest desired degree. The variables that violated the *t*-test assumptions and therefore were analyzed using the nonparametric Mann-Whitney U test were: concern for finances, level of math completed, level of science completed, and distance of college from permanent home.

Intention to Transfer

The effect of all independent variables (age, gender, ethnicity, native language, mother's education, father's education, level of math completed, level of science completed, financial concerns, marital status, distance from home, hours worked, highest desired degree, enrollment status, college status, peer engagement, faculty/staff encouragement/assistance, transfer engagement, and faculty engagement on coursework) on the dependent variable intention to transfer were analyzed. All nominal and dichotomous variables were analyzed using cross-tabulations with the Pearson chi-square test, normally distributed ordinal variables were analyzed using the independent samples *t*-test, and ordinal variables that violated the assumptions of equality or normality were analyzed using the Mann-Whitney U test.

Cross-tabulations and Pearson chi-square tests. Cross-tabulations and Pearson chi-square tests were utilized to analyze the nominal and dichotomous variables: ethnicity, gender, native language, marital status, mother's highest level of completed education, father's highest level of completed education, enrollment status, college status, transfer engagement, peer engagement, faculty/staff encouragement/assistance, and faculty engagement on coursework. Prior to conducting the analysis, the assumptions of the cross-tabulation and Pearson chi-square tests were checked and met: the data for the variables were independent, the variables were nominal, and at least 80% of the expected cell frequencies were greater than or equal to 5 (Morgan et al., 2007, p. 104). Cross-tabulations and Pearson chi-square tests determined if specified groups of students were more or less likely than expected to intend to transfer to a 4-year institution. The effect sizes of the dichotomous variables were analyzed using the phi coefficient, and the effect size of the polytomous nominal variables was determined by the use of Cramer's *V* (Morgan et al., 2007).

The cross-tabulation and Pearson chi-square results for the nominal variable ethnicity are shown in Table 4.11. The results indicate that students' intention to transfer to a 4-year college or university differed significantly by ethnicity, $\chi^2 = 35.652$, $df = 7$, $N = 4667$, $p \leq .001$. American Indian/Alaskan Native, Asian, Black/African American and Hispanic students were more likely than expected to intend to transfer. Students who were of two or more races or who indicated that their ethnicity was unknown also were more likely than expected to intend to transfer to a 4-year institution. Students who intended to transfer were less likely than expected to be White/Caucasian or Native Hawaiian/Pacific Islander. Cramer's *V*, which indicates the strength of the association between the variables, was .087. This effect size is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.11

Ethnicity/Intention to Transfer Cross-Tabulation

Variable	*n*	Intent to transfer? No	Intent to transfer? Yes	χ^2	*p*	*df*
Ethnicity				35.652	<.001	7
American Indian/Alaskan Native	33	9	24			
Asian	91	22	69			
Black/African American	190	55	135			
Hispanic	122	50	72			
Native Hawaiian/Pacific Islander	10	5	5			
White/Caucasian	4,017	1,758	2,259			
Two or more races	161	62	99			
Unknown	43	14	29			
Total	4,667	1,975	2,696			

Note. Cramer's *V* = .087.

The results of the cross-tabulation and Pearson chi-square test for the dichotomous variable gender are displayed in Table 4.12. The analysis revealed that the intention to transfer to a 4-year institution was significantly different between male and female community college students, $\chi^2 = 19.752$, $df = 1$, $N = 4{,}661$, $p \leq .001$. The analysis indicated that students who intended to transfer to a 4-year institution were more likely than expected

Table 4.12

Gender/Intention to Transfer Cross-Tabulation

Variable	*n*	Intent to transfer? No	Intent to transfer? Yes	χ^2	*p*	*df*
Gender				19.752	<.001	1
Male	1,272	473	799			
Female	3,389	1,505	1,884			
Total	4,661					

Note. Phi = –0.065.

to be male, whereas females were less likely than expected to transfer. The phi coefficient, which indicates the strength of association between the two variables, was –0.080. This effect size is considered to be small (J. Cohen, 1988; Morgan et al. 2007).

Displayed in Table 4.13 are the results of the cross-tabulation and Pearson chi-square test for the dichotomous variable native language. The statistical analysis indicated that native English speakers and nonnative English speakers differed significantly on their intention to transfer to a 4-year college or university, $\chi^2 = 30.171$, $df = 1$, $N = 4{,}428$, $p \leq .001$. Non-native English speaking students were more likely than expected to intend to transfer, and native English speaking students were less likely than expected to intend to transfer.

Table 4.13

Native Language/Intention to Transfer Cross-Tabulation

		Intent to transfer?				
Variable	*n*	No	Yes	χ^2	*p*	*df*
Native Language				30.171	<.001	1
Other (non-English)	234	59	175			
English	4,428	1,923	2,505			
Total	4,662	1,982	2,680			

Note. Phi = –0.080.

The results of the cross-tabulation and Pearson chi-square analysis of the nominal variable marital status are displayed in Table 4.14. The tests revealed that statistical significance exists between marital statuses on the dependent variable intention to transfer, $\chi^2 = 123.891$, $df = 3$, $N = 4{,}659$, $p \leq .001$. Single students were more likely than expected to intend to transfer to a 4-year institution. Students who intended to transfer were less likely to be married, living together (but not married), or divorced/separated/widowed. Cramer's *V*, which indicates the strength of association between the variables, was .163. This effect size is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.14

Marital Status/Intention to Transfer Cross-Tabulation

Variable	*n*	Intent to transfer? No	Intent to transfer? Yes	χ^2	*p*	*df*
Marital status				123.891	<.001	3
Married	1,297	665	632			
Living together (not married)	655	297	358			
Single, never married	2,162	736	1,426			
Divorced/separated/widowed	545	280	265			
Total	4,659	1,978	2,681			

Note. Cramer's *V* = .163.

The cross-tabulation and Pearson chi-square results for the nominal variable mother's highest level of completed education are displayed in Table 4.15. The tests revealed that students intended to transfer at significantly different rates based on their mother's highest level of completed education, $\chi^2 = 75.297$, $df = 8$, $N = 4{,}652$, $p \leq .001$. Students whose mothers completed elementary school or less, some college, an associate's degree, a bachelor's degree, some graduate school, or a graduate degree were more likely than expected to intend to transfer to a 4-year college or university. Students whose mothers completed some high school or were a high school graduate as their highest level of education were less likely to intend to transfer. Students who indicated that they didn't know their mother's highest level of education also were less likely to intend to transfer to a 4-year institution. Cramer's *V*, which indicates the strength of association between the variables, was .127. This effect size is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.15

Mother's Highest Level of Completed Education/Intention to Transfer Cross-Tabulation

Variable	*n*	Intent to transfer? No	Intent to transfer? Yes	χ^2	*p*	*df*
Mother's highest level of completed education				75.297	<.001	8
Elementary school or less	129	54	75			
Some high school	365	193	172			
High school graduate	1,454	695	759			
Some college	889	363	526			
Associate's degree	831	318	513			
Bachelor's degree	575	188	387			
Some graduate school	69	29	40			
Graduate degree	255	86	169			
I don't know	85	46	39			
Total	4,652	1,972	2,680			

Note. Cramer's *V* = .127.

Displayed in Table 4.16 are the results for the cross-tabulations and Pearson chi-square analysis of the nominal variable father's highest level of completed education. The analysis revealed that students differed significantly on their intention to transfer based on their father's highest level of completed education, $\chi^2 = 65.407$, $df = 8$, $N = 4{,}671$, $p \leq .001$. The tests indicated that students whose fathers completed some college, an associate's degree, a bachelor's degree, some graduate school, or a graduate degree as his highest level of education were more likely than expected to intend to transfer to a 4-year institution. Students who intended to transfer were less likely to transfer than expected when they have fathers who completed elementary school or less, had some high school education or were a high school graduate as their highest level of education. Students who responded that they didn't know their father's highest level of completed education also were less likely than expected to intend to transfer. Cramer's *V*, which indicates the strength of association between the variables, was .118. This effect size is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.16

Father's Highest Level of Completed Education/Intention to Transfer Cross-Tabulation

Variable	*n*	Intent to transfer? No	Intent to transfer? Yes	χ^2	*p*	*df*
Father's highest level of completed education				65.407	<.001	8
Elementary school or less	165	92	73			
Some high school	455	218	237			
High school graduate	1708	777	931			
Some college	752	285	467			
Associate's degree	557	233	324			
Bachelor's degree	513	173	340			
Some graduate school	34	14	20			
Graduate degree	247	73	174			
I don't know	24	113	127			
Total	4671	1978	2693			

Note. Cramer's V = .118.

The dichotomous variable enrollment status was analyzed using cross-tabulations and the Pearson chi-square test. The results of the analysis are shown in Table 4.17. The tests indicated that part-time and full-time students differed significantly on their intention to transfer, $\chi^2 = 36.220$, $df = 1$, $N = 4{,}669$, $p \leq .001$. The analysis revealed that students who were attending on a full-time basis were more likely than expected to intend to transfer to a 4-year institution. Students who intended to transfer to a 4-year college or university were less likely than expected to be attending college on a part-time basis. The phi coefficient, which indicates the strength of association between the two variables, was .088. This effect size is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.17

Enrollment Status/Intention to Transfer Cross-Tabulation

		Intent to transfer?				
Variable	*n*	No	Yes	χ^2	*p*	*df*
Enrollment status				36.220	$\leq .001$	1
Part time	1,407	689	718			
Full time	3,262	1,288	1,974			
Total	4,669	1,977	2,692			

Note. Phi = 0.088.

The results of the cross-tabulation and Pearson chi-square test for the dichotomous variable college status are displayed in Table 4.18. The analysis revealed that statistically significant differences did exist between students who were enrolled in their first semester in college and students who had attended college prior to the Fall 2012 semester on their intention to transfer to a 4-year college or university, $\chi^2 = 7.954$ $df = 1$, $N = 4{,}670$, $p \leq .005$. Students who intended to transfer were more likely than expected to be enrolled in their first semester of college. Students who had previously attended college were less likely than expected to intend to transfer to a 4-year institution. The phi coefficient, which indicates the strength of association between the two variables, was 0.041. This effect size is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.18

College Status/Intention to Transfer Cross-Tabulation

		Intent to transfer?				
Variable	*n*	No	Yes	χ^2	*p*	*df*
College status				7.954	$\leq .005$	1
1st semester	703	264	439			
Not 1st semester	3,967	1,716	2,251			
Total	4,670	1,980	2,690			

Note. Phi = 0.041.

Displayed in Table 4.19 are the results of the cross-tabulation and Pearson chi-square analysis for nominal variable transfer engagement. The tests indicated that students' transfer intentions differed significantly on the amount of engagement they incurred in the transfer process, $\chi^2 = 588.714$, $df = 6$, $N = 4,631$, $p \leq .001$. Students who slightly agreed, agreed, or strongly agreed that they used transfer engagement while attending the community college were more likely than expected to intend to transfer. Students who intended to transfer were less likely than expected to have responded that they strongly disagreed, disagreed, or slightly disagreed that they encountered transfer engagement during their time at the community college. Students who indicated that they neither agreed nor disagreed about their use of transfer engagement were less likely than expected to intend to transfer. Cramer's *V*, which indicates the strength of association between the variables, was .357. This effect size is considered to be medium (J. Cohen, 1988; Morgan et al., 2007).

Table 4.19

Transfer Engagement/Intention to Transfer Cross-Tabulation

		Intent to transfer?				
Variable	*n*	No	Yes	χ^2	*p*	*df*
Transfer engagement				588.714	<.001	1
Neither agree nor disagree	310	176	134			
Strongly disagree	685	392	293			
Disagree	1,043	619	424			
Slightly disagree	873	417	456			
Slightly agree	732	216	516			
Agree	613	91	522			
Strongly agree	375	51	324			
Total	4,631	1,962	2,669			

Note. Cramer's *V* = .357.

The results of the cross-tabulation and Pearson chi-square for the nominal variable peer engagement are displayed in Table 4.20. The analysis revealed that there was no significant difference between the levels of peer engagement and students' intentions to transfer, $\chi^2 = 2.922$, $df = 3$, $N = 4{,}581$, $p > .05$. Cramer's *V*, which indicates the strength of association between the variables, was .025, which is considered to be a small effect size (J. Cohen, 1988; Morgan et al., 2007).

Table 4.20

Peer Engagement/Intention to Transfer Cross-Tabulation

Variable	*n*	Intent to transfer? No	Intent to transfer? Yes	χ^2	*p*	*df*
Peer engagement				2.922	>.05	3
Did not use/receive	1,375	587	788			
Used/received not helpful	1,184	482	702			
Used/received somewhat helpful	1,167	515	652			
Used/received very helpful	855	359	496			
Total	4,581	1,943	2,638			

Note. Cramer's *V* = .025.

The cross-tabulation and Pearson chi-square results for the nominal variable faculty/staff encouragement/assistance are displayed in Table 4.21. The analysis revealed that students who received encouragement or assistance from faculty or staff members did not differ significantly on their intentions to transfer to a 4-year institution, $\chi^2 = 1.488$, $df = 3$, $N = 4{,}543$, $p > .05$. Cramer's *V*, which indicates the strength of the association between the variables, was .018, which is considered to be a small effect size (J. Cohen, 1988; Morgan et al., 2007).

Table 4.21

Faculty and Staff Encouragement and Assistance/Intention to Transfer Cross-Tabulation

Variable	n	Intent to transfer? No	Intent to transfer? Yes	χ^2	p	df
Faculty/staff encouragement/assistance				1.488	>.05	3
Did not use/receive	2,132	912	1,220			
Used/received not helpful	1,762	740	1,022			
Used/received somewhat helpful	532	220	312			
Used/received very helpful	117	44	73			
Total	4,543	916	2,627			

Note. Cramer's V = .018.

Table 4.22 displays the results of the cross-tabulations and Pearson chi-square analysis for the nominal variable faculty engagement on coursework. The results revealed that no significant difference existed between the number of times students engaged with faculty on their coursework and their intention to transfer to a 4-year college or university, $\chi^2 = 4.597$, $df = 4$, $N = 4{,}634$, $p > .05$. Cramer's V, indicating the strength of the association, was .031, which is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.22

Faculty Engagement on Coursework/Intention to Transfer Cross-Tabulation

Variable	n	Intent to transfer? No	Intent to transfer? Yes	χ^2	p	df
Faculty engagement on coursework				4.597	>.05	4
Never or very rarely	504	225	279			
A few times per semester	1686	727	959			
About once a month	1097	462	635			
Several times a month	924	384	540			
Several times a week	423	162	261			
Total	4634	1960	2674			

Note. Cramer's V = .031.

The cross-tabulations and Pearson chi-square analyses indicated that nine variables (ethnicity, gender, native language, marital status, mother's highest level of completed education, father's highest level of completed education, enrollment status, college status, and transfer engagement) revealed significant differences between students who did and those who did not intend to transfer to a 4-year college or university. Three variables (peer engagement, faculty/staff encouragement/assistance, and faculty engagement on coursework) revealed that no significant difference existed between students who did and those who did not intend to transfer to a 4-year institution.

Independent samples *t*-test. All ordinal variables were analyzed on the three assumptions of the independent samples *t*-test. The three assumptions of the *t*-test require that variables must have equal variance of the distribution of the dependent variable within the population of the independent variable, the dependent variable must be equally distributed within the population of the independent variable, and the independent variable must be independent of the results of other variables (Morgan et al., 2007). Three ordinal variables did not markedly violate the assumptions of the *t*- test for the dependent variable intention to transfer: age, concern for finances, and hours worked at a job for pay weekly. Displayed in Table 4.23 are the results of the independent samples *t*-tests for the three variables.

The independent samples *t*-test revealed that students who intended to transfer to a 4-year institution and students who did not intend to transfer were significantly different on the ordinal variable age, $t = 13.194$, $df = 4{,}659$, $p < .001$. The average age for students who did not intend to transfer ($M = 1.902$) was significantly higher than the average age for students who intended to transfer ($M = 1.613$). This indicates that students who intended to transfer were significantly younger than were those who did not intend to transfer to a 4-year institution. The effect size, *d,* was .391, which is considered to be medium (J. Cohen, 1988; Morgan et al., 2007).

Table 4.23

Independent Sample t-*Test of Intention to Transfer*

Variable	*M*	*SD*	*t*	*df*	*p*	95% CI Lower	95% CI Upper
Age			13.19	4,659	.000***	1.900	0.769
No intention to transfer	1.902	0.769					
Intention to transfer	1.613	0.717					
Concern for finances			–6.40	4,683	.000***	–0.171	–0.091
No intention to transfer	1.930	0.694					
Intention to transfer	2.060	0.691					
Hours worked for pay weekly			1.07	3,182	.284	–0.045	0.153
No intention to transfer	3.690	1.416					
Intention to transfer	3.640	1.381					

***$p < .001$.

The analysis of the results of an independent sample *t*-test indicates that students who intended to transfer and those who did not intend to transfer differed significantly on the ordinal variable concern about finances, $t = –6.404$, $df = 4{,}683$, $p < .001$. The mean concern about finances for students who intended to transfer ($M = 2.06$) was significantly higher than that for students who had no intention of transferring ($M = 1.93$) to a 4-year institution. This reveals that students who intended to transfer were significantly more concerned about their ability to finance their education than were students who did not intend to transfer. The effect size, *d*, which was –0.189, is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

The independent samples *t*-test for the ordinal variable number of hours worked for pay weekly, $t = 1.072$, $df = 3{,}182$, $p = 2.84$, indicated that there was no statistically significant difference between students who intended to transfer and those students who did not intend to transfer. This indicates that there was no significant difference between the means of students who intended to transfer ($M = 3.69$) and those who did not intend to transfer ($M = 3.64$) on the number of hours they were working weekly for pay. The effect size, *d*, was 0.039, which is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

The results of the independent samples *t*-test revealed that two variables (age and concern for finances) showed statistically significant differences between the means of students who intended to transfer and those who did not intend to transfer. The variable hours worked at a job for pay weekly did not reveal significance between the means of students who intended to transfer to a 4-year institution and those who did not intend to transfer to a 4-year college or university.

Mann-Whitney U test. The ordinal variables that markedly violated the assumptions of the independent samples *t*-test were analyzed using the nonparametric Mann-Whitney U test. The Mann-Whitney U test is used to analyze the difference between two groups (for this study, intention to transfer and no intention to transfer). According to Urdan (2010), the nonparametric Mann-Whitney U test should be considered "if the variances of the two samples are grossly unequal, the sample sizes are very different, and/or the data are not normally distributed" (p. 96). The assumptions of the Mann-Whitney U test were scrutinized and four variables were analyzed: level of math completed, level of science completed, distance of college from permanent home, and highest desired degree.

The results of the Mann-Whitney U test for the ordinal variable level of math completed are displayed in Table 4.24. The results of the analysis revealed that students who intended to transfer (*n* = 2,707) had a significantly higher mean rank (*M* = 2,435.64) than did students who did not intend to transfer (*M* = 2,233.62; *n* = 1,992) for the level of math completed variable, *U* = 1,579,285.50, $p < .001$. This indicates that students who intended to transfer completed more math courses than did students who did not intend to transfer. The effect size, *r*, was –.099, which is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.24

Comparison of Students Who Intended to Transfer and Students Who Did Not Intend to Transfer on Level of Math Completed

Variable	Mean rank	Mann-Whitney *U*	*p* (2-tailed)	*r*
Level of math completed		1,579,285.50	<.001	–.162
No intention to transfer	2,253.99			
Intention to transfer	2,640.96			

Displayed in Table 4.25 are the results of the Mann-Whitney U test for the ordinal variable level of science completed. The analysis revealed that students who intended to transfer (*n* = 2,707) had a significantly higher mean rank (*M* = 2,446.24) than did students who did not intend to transfer (*M* = 2,219.22; *n* = 1,992) for the level of science completed variable, *U* = 2,435,654.50, $p < .001$. The results indicate that students who intended to transfer completed more science courses than did students who did not intend to transfer. The effect size, *r*, was –.101, which is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.25

Comparison of Students Who Intended to Transfer and Students Who Did Not Intend to Transfer on Level of Science Completed

Variable	Mean rank	Mann-Whitney *U*	*p* (2-tailed)	*r*
Level of science completed		2,435,654.50	<.001	–.101
No intention to transfer	2,219.22			
Intention to transfer	2,446.24			

The results of the Mann-Whitney U test for the ordinal variable distance of college from permanent home are displayed in Table 4.26. The analysis revealed that there was no significant difference in the mean rank of students who intended to transfer (*M* = 2,340.80) (*n* = 2,686) and those who did not intend to transfer (*M* = 2,325.96; *n*= 1,982) for the distance of college from permanent home variable, *U* = 2,644,900.00, *p* =.531. The effect size, *r*, was –.009, which is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.26

Comparison of Students Who Intended to Transfer and Students Who Did Not Intend to Transfer on Distance of College from Permanent Home

Variable	Mean rank	Mann-Whitney *U*	*p* (2-tailed)	*r*
Distance of college from permanent home		2,644,900.00	.531	–.009
No intention to transfer	2,325.96			
Intention to transfer	2,340.80			

Displayed in Table 4.27 are the results of the Mann-Whitney U test for the ordinal variable highest desired degree. The results indicate that students who intended to transfer (*n* = 2,700) had a significantly higher mean rank (*M* = 2,801.42) than did students who did not intend to transfer (*M* = 1,722.45; *n* = 1,987) for the highest desired degree variable, *U* =

1,447,421.00, $p < .001$. This indicates that students who intended to transfer had higher degree aspirations than did students who did not intend to transfer. The effect size, r, was –.403, which is considered medium to large (J. Cohen, 1988; Morgan et al., 2007).

Table 4.27

Comparison of Students Who Intended to Transfer and Students Who Did Not Intend to Transfer on Highest Desired Degree

Variable	Mean rank	Mann-Whitney U	p (2-tailed)	r
Highest desired degree		1,447,421.00	<.001	–0.403
No intention to transfer	1,722.45			
Intention to transfer	2,801.42			

The Mann-Whitney U test revealed that statistically significant differences existed between students who intended to transfer and those who did not intend to transfer for the ordinal variables level of math completed, level of science completed, and highest desired degree. The distance of college from permanent home variable did not show a statistically significant difference between the students who intended to transfer and those who did not intend to transfer to a 4-year institution.

STEM Aspirations

The independent variables (age, gender, ethnicity, native language, mother's highest level of education, father's highest level of education, level of math completed, level of science completed, concern for finances, distance of college from permanent home, number of hours worked for pay weekly, highest desired degree, enrollment status, college status, peer engagement, transfer engagement, faculty/staff encouragement/assistance, and faculty engagement on coursework) were analyzed on the dependent variable STEM aspirations.

Cross-tabulations and Pearson chi-square tests were used to analyze the dichotomous and nominal variables. Normally distributed ordinal variables were analyzed using the independent samples *t*-test, whereas ordinal variables that markedly violated the assumptions of the *t*-test were analyzed using the Mann-Whitney U test.

Cross-tabulations and Pearson chi-square tests. Cross-tabulations and Pearson chi-square tests were used to analyze the nominal and dichotomous variables ethnicity, gender, native language, marital status, mother's highest level of education, father's highest level of education, enrollment status, college status, peer engagement, transfer engagement, faculty/ staff encouragement/assistance, and faculty engagement on coursework. Prior to conducting the analysis, the assumptions of the cross-tabulation and Pearson chi-square tests were checked and met: the data for the variables were independent, the variables were nominal, and at least 80% of the frequencies were greater than or equal to 5 (Morgan et al., 2007, p. 104). Cross-tabulations and Pearson chi-square tests determined if students were more likely than expected to have STEM aspirations based on their demographic characteristics or level of engagement. The phi coefficient was used to analyze the effect size of dichotomous variables, and Cramer's *V* was utilized to evaluate the effect size of the nominal variables (Morgan et al., 2007).

The results of the cross-tabulations and Pearson chi-square test for the nominal variable ethnicity are shown in Table 4.28. The analysis revealed that students of different ethnicities differed significantly on their STEM aspirations, $\chi^2 = 22.058$, $df = 7$, $N = 4{,}648$, $p \leq .005$. Students with STEM aspirations were more likely than expected to be American Indian/Alaskan Native, Asian, Black or Hispanic. Students who indicated that they were two or more races or that their ethnicity was unknown were more likely than expected to have

STEM aspirations. White/Caucasian students were less likely than expected to have STEM aspirations. Cramer's *V*, which indicates the strength of association between the variables, was .069, which is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.28

Ethnicity/STEM Aspirations Cross-Tabulation

		STEM aspirations?				
Variable	*n*	No	Yes	χ^2	*p*	*df*
Ethnicity				22.058	≤.005	7
American Indian/Alaskan Native	33	24	9			
Asian	90	56	34			
Black/African American	188	135	53			
Hispanic	120	89	31			
Native Hawaiian/Pacific Islander	9	7	2			
White/Caucasian	4,007	3,154	853			
Two or more races	160	124	36			
Unknown	41	28	13			
Total	4,648	3,617	1,031			

Note. Cramer's *V* = .069

The cross-tabulation and Pearson chi-square test results for the dichotomous variable gender are shown in Table 4.29. The results indicate that STEM aspirations were significantly different between male and female students, $\chi^2 = 75.719$, $df = 1$, $N = 4{,}642$, $p \leq .001$. The analysis showed that male students were more likely than expected to have STEM aspirations. Students with STEM aspirations were less likely than expected to be female. The phi coefficient, indicating the strength of the association between the two variables, was –0.128. This effect size is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.29

Gender/STEM Aspirations Cross-Tabulation

Variable	n	STEM aspirations? No	STEM aspirations? Yes	χ^2	p	df
Gender				75.719	≤.001	1
Male	1,266	876	390			
Female	3,376	2,738	638			
Total	4,642	3,614	1,028			

Note. Phi = 0.128

The results of the cross-tabulation and Pearson chi-square test for the dichotomous variable native language are displayed in Table 4.30. The analysis revealed that non-native English speaking students and native English speaking students differed significantly on the dependent variable STEM aspirations, χ = 53.358, df = 1, N = 4,644, $p \leq .001$. The results indicate that students with STEM aspirations were more likely than expected to be non-native English speakers. Native English speaking students were less likely than expected to have STEM aspirations. The phi coefficient, which indicates the strength of association between the two variables, was –0.107, which is considered to be a small effect size (J. Cohen, 1988; Morgan et al., 2007).

Table 4.30

Native Language/STEM Aspirations Cross-Tabulation

Variable	n	STEM aspirations? No	STEM aspirations? Yes	χ^2	p	df
Native language				53.358	≤.001	1
Other (non-English)	231	135	96			
English	4,413	3,482	931			
Total	4,644	3,617	1,027			

Note. Phi = 0.107.

Displayed in Table 4.31 are the results of the cross-tabulation and Pearson chi-square test for the nominal variable marital status. The tests revealed that students' STEM aspirations did not differ significantly among marital statuses, $\chi^2 = 6.138$, *df* = 3, *N* = 4,640, $p > .05$. Cramer's *V*, which indicates the strength of association between the variables, was .036. This effect size is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.31

Marital Status/STEM Aspirations Cross-Tabulation

		STEM aspirations?				
Variable	*n*	No	Yes	χ^2	*p*	*df*
Marital status				6.138	>.05	3
Married	1,287	1,016	271			
Living together (not married)	657	528	129			
Single, never married	2,153	1,644	509			
Divorced/separated/widowed	543	425	118			
Total	4,640	3,613	1,027			

Note. Cramer's *V* = .036.

The results of the cross-tabulation and Pearson chi-square analysis of the nominal variable mother's highest level of completed education are displayed in Table 4.32. The analysis revealed that students differed significantly on their intention to transfer based on their mother's highest level of completed education, $\chi^2 = 24.732$, *df* = 8, *N* = 4,632, $p \leq .005$. The results indicate that students whose mother had completed elementary school or less, some college, an associate's degree, a bachelor's degree, some graduate school, or a graduate degree as her highest level of education were more likely than expected to have STEM aspirations. Students with STEM aspirations were less likely than expected to have mothers who completed some high school or a high school diploma as their highest level of education. Students who indicated they didn't know their mother's highest completed education also were less likely than expected to have STEM aspirations. Cramer's *V*, which indicates the strength of association between the variables, was .073, which is considered to be a small effect size (J. Cohen, 1988; Morgan et al., 2007).

Table 4.32

Mother's Highest Level of Completed Education/STEM Aspirations Cross-Tabulation

		STEM aspirations?				
Variable	*n*	No	Yes	χ^2	*p*	*df*
Mother's highest level of completed education				24.732	≤.005	8
Elementary school or less	129	89	40			
Some high school	362	291	71			
High school graduate	1,446	1,157	289			
Some college	887	690	197			
Associate's degree	831	645	186			
Bachelor's degree	572	427	145			
Some graduate school	69	49	20			
Graduate degree	251	182	69			
I don't know	85	74	11			
Total	4,632	3,604	1,028			

Note. Cramer's *V* = .073.

The cross-tabulation and Pearson chi-square results for the nominal variable father's highest level of completed education can be found in Table 4.33. The tests indicate that students possessed STEM aspirations at significantly different rates based on their father's highest level of completed education, $\chi^2 = 21.170$, $df = 8$, $N = 4{,}632$, $p \leq .005$. The analysis revealed that students with STEM aspirations were more likely than expected to have fathers who completed some high school, some college, an associate's degree, a bachelor's degree, some graduate school, or a graduate degree as their highest level of education. Students whose fathers completed elementary school or less or were high school graduates were less likely than expected to have STEM aspirations. Students who indicated that they did not know their father's highest level of completed education were also less likely than expected to have STEM aspirations. Cramer's *V*, indicating the strength of association between the variables, was .067. This effect size is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.33

Father's Highest Level of Completed Education/STEM Aspirations Cross-Tabulation

		STEM aspirations?				
Variable	*n*	No	Yes	χ^2	*p*	*df*
Father's highest level of completed education				21.170	≤.01	8
Elementary school or less	163	129	34			
Some high school	454	352	102			
High school graduate	1,702	1,351	352			
Some college	752	565	187			
Associate's degree	555	439	116			
Bachelor's degree	509	387	122			
Some graduate school	33	21	13			
Graduate degree	245	176	69			
I don't know	237	197	40			
Total	4,651	3,617	1,034			

Note. Cramer's *V* = .067.

Displayed in Table 4.34 are the results of the cross-tabulation and Pearson chi-square analysis of the dichotomous variable enrollment status. The results revealed that students who were attending college on a part-time basis differed significantly from students who were attending college full time on their aspirations to major in a STEM-related field, χ^2 = 5.070, $df = 1$, $N = 4{,}650$, $p \leq .05$. The analysis indicates that students who had STEM aspirations were more likely than expected to be attending college on a full-time basis.

Students who were enrolled part-time were less likely than expected to have STEM aspirations. The phi, which indicates the strength of association between the two variables, was 0.033, which is considered to be a small effect size (J. Cohen, 1988; Morgan et al., 2007).

Table 4.34

Enrollment Status/STEM Aspirations Cross-Tabulation

Variable	*n*	STEM aspirations? No	STEM aspirations? Yes	χ^2	*p*	*df*
Enrollment status				5.070	$\leq .05$	1
Part-time	1,402	1,121	281			
Full-time	3,248	2,500	748			
Total	4,650	3,621	1,029			

Note. Phi = 0.033.

The dichotomous variable college status was analyzed using cross-tabulations and the Pearson chi-square test. The results of the analysis are found in Table 4.35. The analysis revealed that students who were enrolled in their first semester of college and students who had attended college prior to the Fall 2012 semester did not differ significantly on the

Table 4.35

College Status/STEM Aspirations Cross-Tabulation

Variable	*n*	STEM aspirations? No	STEM aspirations? Yes	χ^2	*p*	*df*
College status				0.038	$>.05$	1
1st semester	698	549	149			
Not 1st semester	3,952	3,071	881			
Total	4,650	3,620	1,030			

Note. Phi = 0.080.

intention to major in a STEM-related field, $\chi^2 = 0.308$, $df = 1$, $N = 4{,}650$, $p > .05$. The phi coefficient, which indicates the strength of association between the two variables, was 0.008. This effect size is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

The cross-tabulation and Pearson chi-square test results for the nominal variable transfer engagement are shown in Table 4.36. The tests indicate that statistically significant differences exist between the amount of engagement students encountered in the transfer process and their STEM aspirations, $\chi^2 = 70.025$, $df = 6$, $N = 4{,}613$, $p \leq .001$. The analysis

Table 4.36

Transfer Engagement/STEM Aspirations Cross-Tabulation

		STEM aspirations?				
Variable	*n*	No	Yes	χ^2	*p*	*df*
Transfer engagement				70.025	≤.001	6
Neither agree nor disagree	309	258	51			
Strongly disagree	686	561	125			
Disagree	1036	861	175			
Slightly disagree	869	679	190			
Slightly agree	730	539	191			
Agree	606	433	173			
Strongly agree	377	257	120			
Total	4613	3588	1025			

Note. Cramer's *V* = .123.

revealed that students who intended to major in STEM were more likely than expected to slightly agree, agree, or strongly agree that they experienced engagement in the transfer process. Students who responded that they strongly disagreed, disagreed, or slightly disagreed that they encountered transfer engagement were less likely than expected to have STEM aspirations. Students who indicated that they neither agreed nor disagreed about their use of transfer engagement were also less likely than expected to have STEM aspirations. Cramer's *V*, which indicates the strength of association between the variables, was .123, which is considered to be a small effect size (J. Cohen, 1988; Morgan et al., 2007).

The nominal variable peer engagement was analyzed using cross-tabulations and the Pearson chi-square test. The results of the analysis are shown in Table 4.37. The analysis indicated that significant differences existed between the levels of peer engagement and students' STEM aspirations, $\chi^2 = 8.934$, $df = 3$, $N = 4{,}560$, $p \leq .05$. The results revealed that students who indicated that peer engagement was not helpful, somewhat helpful, or very helpful were more likely than expected to have STEM aspirations. Students with STEM aspirations were less likely than expected to respond that they did not use peer engagement. Cramer's *V*, which indicates the strength of the association between the variables, was .044. This effect size is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.37

Peer Engagement/STEM Aspirations Cross-Tabulation

		STEM aspirations?				
Variable	*n*	No	Yes	χ^2	*p*	*df*
Peer engagement				8.934	<.05	3
Did not use/receive	1,365	1,098	267			
Used/received not helpful	1,184	916	268			
Used/received somewhat helpful	1,159	885	274			
Used/received very helpful	852	646	206			
Total	4,560	3,545	1,015			

Note. Cramer's *V* = .123.

The results of the cross-tabulation and Pearson chi-square analysis for the nominal variable faculty/staff encouragement/assistance are displayed in Table 4.38. The results show that students' STEM aspirations differed significantly on the levels of faculty/staff encouragement/assistance, $\chi^2 = 10.753$, $df = 3$, $N = 4{,}525$, $p \leq .05$. The analysis indicates that students with STEM aspirations were more likely than expected to identify encouragement or assistance from staff or faculty members as not helpful or very helpful. Students who indicated that faculty/staff encouragement/assistance was somewhat helpful were less likely than expected to have STEM aspirations. Students who indicated that they did not utilize encouragement or assistance from faculty or staff members also were less likely than expected to have STEM aspirations. Cramer's *V*, which indicates the strength of association between the variables, was .049, which is considered to be a small effect size (J. Cohen, 1988; Morgan et al., 2007).

Table 4.38

Faculty–Staff Encouragement or Assistance/STEM Aspirations Cross-Tabulation

		STEM aspirations?				
Variable	*n*	No	Yes	χ^2	*p*	*df*
Faculty/staff encouragement/assistance				10.753	<.05	3
Did not use/receive	2,127	1,686	441			
Used/received not helpful	1,755	1,334	421			
Used/received somewhat helpful	526	411	115			
Used/received very helpful	117	81	36			
Total	4,525	3,512	1,013			

Note. Cramer's *V* = .049.

Displayed in Table 4.39 are the results of the cross-tabulation and Pearson chi-square analysis for the nominal variable faculty engagement on coursework. The analysis revealed that significant differences existed between the levels of engagement with faculty on coursework and students' STEM aspirations, $\chi^2 = 15.134$, $df = 4$, $N = 4616$, $p \leq .005$.

Students who were more likely than expected to have STEM aspirations indicated that they engaged with faculty on coursework once per month, several times per month, or several times per week. Students who indicated that they engaged with faculty on coursework a few times per semester were less likely than expected to have STEM aspirations. Students who responded that they never engaged with faculty regarding coursework also were less likely than expected to have STEM aspirations. Cramer's *V*, which indicates the strength of association between the variables, was .057. This is considered to be a small effect size (J. Cohen, 1988; Morgan et al., 2007).

Table 4.39

Faculty Engagement on Coursework/STEM Aspirations Cross-Tabulation

		STEM aspirations?				
Variable	*n*	No	Yes	χ^2	*p*	*df*
Faculty engagement on coursework				15.130	≤.005	4
Never or very rarely	505	422	83			
A few times per semester	1,681	1,317	364			
About once a month	1,088	835	253			
Several times a month	918	705	213			
Several times a week	424	313	111			
Total	4,616	3,592	1,024			

Note. Cramer's *V* = 0.057.

In summary, the cross-tabulation and Pearson Chi-square analyses indicated that 11 variables (ethnicity, gender, native language, marital status, mother's highest level of completed education, father's highest level of completed education, enrollment status, transfer engagement, peer engagement, faculty/staff encouragement/assistance, and faculty engagement on coursework) revealed significant differences between students who did and those who did not have STEM aspirations. Two variables (marital status and college status) revealed that no significant difference existed between students who did and those who did not have STEM aspirations.

Independent samples *t*-test. All ordinal variables were analyzed to see if their distributions are consistent with the three assumptions of the independent samples *t*-test. The three assumptions of the *t*-test require that the dependent variable be equally distributed within the independent variable, variables have equal variance of the dependent variable within the independent variable, and the independent variables are mutually independent of the results of other variables (Morgan et al., 2007). Three independent variables (age, number of hours worked for pay weekly, and highest desired degree) did not grossly violate the assumptions of the *t*-test for the dependent variable STEM aspirations. Displayed in Table 4.40 are the results of the independent samples *t*-test for these three variables.

Table 4.40

Independent Sample t-*Test of STEM Aspirations*

						95% CI	
Variable	*M*	*SD*	*t*	*df*	*p*	Lower	Upper
Age			1.831	4,640	.067	–0.003	0.101
No STEM aspiration	1.745	0.758					
STEM aspiration	1.696	0.733					
Hours worked for pay weekly			1.82	3,173	.069	–0.008	0.226
No STEM aspiration	3.690	1.390					
STEM aspiration	3.580	1.407					
Highest desired degree			–15.454	4,665	.000***	-0.848	–0.657
No STEM aspiration	5.130	1.400					
STEM aspiration	5.890	1.322					

****p* < .001.

The analysis of the results of the independent samples *t*-test revealed that students with STEM aspirations and students who did not have STEM aspirations did not differ significantly on the ordinal variable age ($t = 1.831$, $df = 4{,}640$, $p = .067$). This indicates that there was no significant difference between the means of students with STEM aspirations ($M = 1.70$) and students without STEM aspirations ($M = 1.745$) for the independent variable age. The effect size, *d*, was 0.065, which is considered to be small (J. Cohen, 1998; Morgan et al., 2007).

The results of the independent samples *t*-test for the ordinal variable number of hours worked for pay weekly ($t = 1.820$, $df = 3{,}173$, $p = .069$) shows that there was no statistically significant difference between the means of the two groups associated with STEM aspirations. This reveals that there is no significant difference between the means of students with STEM aspirations ($M = 3.580$) and students who did not have STEM aspirations ($M = 3.690$). The effect size, *d*, was 0.078. This is considered to be a small effect size (J. Cohen, 1998; Morgan et al., 2007).

The analysis of the results of the independent samples *t*-test revealed that students with STEM aspirations and students who did not possess STEM aspirations differed significantly on the ordinal variable highest desired degree ($t = –15.454$, $df = 4{,}665$, $p \leq .001$). The average highest desired degree for students who had STEM aspirations ($M = 5.890$) was significantly higher than was the mean desired degree for students who did not have STEM aspirations ($M = 5.130$). This indicates that students who had STEM aspirations had significantly higher desired degree aspirations than students who did not have STEM aspirations. The effect size, *d*, was –0.544, which is considered to be medium to large (J. Cohen, 1988; Morgan et al., 2007).

In summary, the results of the independent samples *t*-test revealed that one variable (highest desired degree) showed a statistically significant difference between the mean responses of students with STEM aspirations and those without STEM aspirations. The variables age and hours worked for pay weekly did not reveal significance between the mean responses of students who have STEM aspirations and students who do not have STEM aspirations.

Mann-Whitney U test. The ordinal variables that markedly violated the assumptions of the independent samples *t*-test were analyzed using the nonparametric Mann-Whitney U test. The Mann-Whitney U test is used to analyze the difference between two groups (for this study, students with STEM aspirations and students without STEM aspirations). According to Urdan (2010) the nonparametric Mann-Whitney U test should be considered "if the variances of the two samples are grossly unequal, the sample sizes are very different, and/or the data are not normally distributed" (p. 96). The assumptions of the Mann-Whitney U test were scrutinized and met, and four variables (level of math completed, level of science completed, concern for finances, and distance of college from permanent home) were analyzed using that method.

Displayed in Table 4.41 are the results of the Mann-Whitney U test for the ordinal variable level of math completed. The results of the analysis revealed that responses of students who had STEM aspirations (M = 2,640.96; n = 1,040) had a significantly higher mean rank than did those of students who did not have STEM aspirations (M = 2,253.99; n = 3,639) on the variable level of math completed, U = 1,579,285.50, $p \leq .001$. The results indicate that students who had STEM aspirations completed more math courses than students who did not have STEM aspirations. The effect size, *r*, was –0.162. This effect size is considered to be a small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.41

Comparison of Students with STEM Aspirations and Students Without STEM Aspirations on Level of Math Completed

Variable	Mean rank	Mann-Whitney *U*	*p* (2-tailed)	*r*
Level of math completed		1,579,285.50	<.001	–0.162
No STEM Aspirations	2,253.99			
STEM Aspirations	2,640.96			

The results of the Mann-Whitney U test for the ordinal variable level of science completed are shown in Table 4.42. The results indicate that students with STEM aspirations (M = 2,688.75; n = 1,040) had a significantly higher mean rank than did students without STEM aspirations (M = 2,240.3; n = 3,639) on the variable level of science completed, U = 1,529,585.00, $p \leq .001$. This suggests that students who had STEM aspirations completed more math courses than students who did not possess STEM aspirations. The effect size, *r*, is –.168, which is considered to be a small effect size (J. Cohen, 1988; Morgan et al., 2007).

Table 4.42

Comparison of Students with STEM Aspirations and Students Without STEM Aspirations on Level of Science Completed

Variable	Mean rank	Mann-Whitney *U*	*p* (2-tailed)	*r*
Level of science completed		1,529,585.00	<.001	–.168
No STEM Aspirations	2,240.33			
STEM Aspirations	2,688.75			

Displayed in Table 4.43 are the results of the Mann-Whitney U test for the ordinal variable concern for finances. The analysis revealed that responses from students who had STEM aspirations (*M* = 2,459.44; *n* = 1,038) had a significantly higher mean rank than from those who did not have STEM aspirations (*M* = 2,2297.47; *n* = 3,628) on the variable concern for finances, *U* = 1,752,211.00, $p \leq .001$. This indicates that students who had STEM aspirations were more concerned about financing their education than were their peers who did not have STEM aspirations. The effect size, *r*, was –0.055. This effect size is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

Table 4.43

Comparison of Students with STEM Aspirations and Students Without STEM Aspirations on Concern for Finances

Variable	Mean rank	Mann-Whitney *U*	*p* (2-tailed)	*r*
Concern for finances		1,752,211.00	<.001	–.055
No STEM Aspirations	2,297.47			
STEM Aspirations	2,459.44			

The results of the Mann-Whitney U test for the ordinal variable distance of college from permanent home are displayed in Table 4.44. The analysis revealed that there was no

Table 4.44

Comparison of Students with STEM Aspirations and Students Without STEM Aspirations on Distance from college to permanent home

Variable	Mean rank	Mann-Whitney *U*	*p* (2-tailed)	*r*
Distance from college to permanent home		1,840,452	0.346	–.014
No STEM Aspirations	2,319.63			
STEM Aspirations	2,346.18			

significant difference in the mean rank of responses of students with STEM aspirations (*M* = 2,346.18) (*n*=1,028) and students with no STEM aspirations (*M* = 2,319.63; *n*=3,622) on the variable distance of college from permanent home, U = 1,840,452.00, p = .346. The effect size, *r*, was –0.014, which is considered to be small (J. Cohen, 1988; Morgan et al., 2007).

In summary, the Mann-Whitney U test revealed that statistically significant differences existed between students who had STEM aspirations and those without STEM aspirations on the ordinal variables level of math completed, level of science completed, and concern for finances. The variable distance of college from permanent home did not show a significant difference between students with STEM aspirations and students who did not have STEM aspirations.

Correlation Analysis

The bivariate Pearson correlation was used to establish the relationships, if any, among the four engagement variables (transfer engagement, peer engagement, faculty/staff encouragement/assistance, and faculty engagement on coursework). Before conducting the Pearson correlation the assumptions were checked and met. Urdan (2010) noted the assumptions of the Pearson product–moment correlation coefficient as both of the variables must be measured on an interval or ratio scale and be known as continuous variables. The variables associated with engagement are continuous variables; therefore they are appropriate for the Pearson correlation (Urdan, 2010).

The direction and magnitude of the correlation (if any) determine if "the values on one variable are associated with the values on a second variable" (Urdan, 2010, p. 83). If a correlation between two variables is positive, one can assume that as one variable increases/decreases the other variable increases/decreases as well. Likewise, a negative correlation indicates that as one variable increases the other variable decreases and vice-versa. The magnitude, or strength, of correlations ranges from –1 to 1. A correlation coefficient between –.20 and .20 indicates a weak relationship, a coefficient between –.20 and –.50 or .20 and .50 reveals a moderate relationship, and a coefficient between –.50 and –.70 or .50 and .70 indicates a strong relationship between the variables (Urdan, 2010; Aron et al., 2005).

Variables that are not normally distributed are analyzed using the nonparametric Spearman's rho, whereas the variables that meet the assumption of normality are analyzed using the Pearson correlation (Urdan, 2010). An analysis of the engagement variables revealed that all variables meet the assumption of normality and, therefore, were analyzed using the Pearson correlation. Two Pearson correlations provided the direction and magnitude of relationships (if any) of the engagement variables on the dependent variables intention to transfer and STEM aspirations.

Intention to Transfer

Students who indicated that they intended to transfer to a 4-year community college were placed in the "intention to transfer" dataset. The dataset was then analyzed using the Pearson correlation on the independent variables transfer engagement, peer engagement, faculty/staff encouragement/assistance and faculty engagement on coursework. Each variable was analyzed on the remaining three variables creating six distinctive correlation results. The results of the Pearson correlation for students who intended to transfer to a 4-year institution are displayed in Table 4.45.

A Pearson correlation was computed between the variables peer engagement and transfer engagement. The correlation revealed that a statistically significant relationship existed between the variables peer engagement and transfer engagement. The correlation coefficient was calculated, $r(2{,}533) = .13$, $p < .001$. The positive correlation indicates that students who frequently engaged with peers also engaged in the transfer process on a regular basis. The strength of the relationship is considered to be small (Morgan et al., 2007; Urdan, 2010). The coefficient of determination, r^2, reveals that 1.7% of the variance in peer engagement could be predicted from transfer engagement (Morgan et al., 2007; Urdan, 2010).

The relationship between peer engagement and faculty/staff encouragement/assistance revealed a statistically significant correlation between the variables. The correlation coefficient was calculated, $r(2{,}533) = .28$, $p < .001$. This positive correlation reveals that students who engaged with their peers on a regular basis also frequently received encouragement or assistance from staff or faculty members. The effect size, r, is considered to be small to medium (J. Cohen, 1988; Morgan et al., 2007; Urdan, 2010). The coefficient of determination, r^2, indicates that 7.6% of the variance in peer engagement can be predicted from faculty/staff encouragement/assistance (Morgan et al., 2007; Urdan, 2010).

Table 4.45

Pearson Correlation of Transfer Engagement, Peer Engagement, Faculty/Staff Encouragement, and Faculty Engagement on Coursework: Students with Transfer Intentions

	Peer engagement	Transfer engagement	Faculty/staff encouragement/ assistance	Faculty engagement on coursework
Peer engagement	—			
Transfer engagement	.127***	—		
Faculty/staff encouragement/assistance	.276***	.304***	—	
Faculty engagement on coursework	.419***	.193***	.328***	—

***$p < .001$

The Pearson correlation of the variables peer engagement and faculty engagement on coursework revealed that statistically significant correlations existed between those variables. The correlation coefficient was calculated, $r(2{,}533) = .42$, $p < .001$. The correlation was positive and, therefore, indicates that as students engaged more often with their peers they also engaged more frequently with faculty on coursework. The strength of the relationship is considered to be moderate (Morgan et al., 2007; Urdan, 2010). The coefficient of determination, r^2, indicates that more than 17.6% of the variance in peer engagement could be predicted from faculty engagement on coursework (Morgan et al., 2007; Urdan, 2010).

The variables transfer engagement and faculty/staff encouragement/assistance were analyzed using the Pearson correlation. The findings indicate that statistically significant relationships existed between the variables transfer engagement and faculty/staff encouragement/assistance. The correlation coefficient was calculated, $r(2{,}533) = .30$, $p < .001$. The positive correlation suggests that students who frequently engaged with counselors and staff members in the transfer process also received encouragement or assistance from faculty or staff members on a regular basis. The effect size, r, is considered to be small to medium (J. Cohen, 1988; Morgan et al., 2007; Urdan, 2010). The coefficient of determination, r^2, indicates that 9.2% of the variance in transfer engagement could be predicted from faculty/staff encouragement/assistance (Morgan et al., 2007; Urdan, 2010).

A Pearson correlation was computed between the variables transfer engagement and faculty engagement on coursework and revealed that statistically significant correlations existed between the variables. The correlation coefficient was calculated, $r(2{,}533) = .19$, $p < .001$. This positive correlation reveals that students who engaged in the transfer process on a regular basis also frequently engaged with faculty on coursework. The strength of the relationship is considered to be small (Morgan et al., 2007; Urdan, 2010). The coefficient of determination, r^2, indicates that 3.7% of the variance in transfer engagement can be predicted from faculty engagement on coursework.

The Pearson correlation of the variables faculty/staff encouragement/assistance and faculty engagement on coursework revealed that statistically significant relationships existed between those two variables. The correlation coefficient was calculated, $r(2{,}533) = .33$, $p < .001$. The correlation was positive and indicates that students who often received encouragement or assistance from faculty or staff members were likely to frequently engage with faculty on coursework. The effect size, r, is considered to be small to medium (J. Cohen, 1988, Morgan et al., 2007). The coefficient of determination, r^2, reveals that 10.8% of the variance in faculty/staff encouragement/assistance can be predicted from faculty engagement on coursework (Morgan et al., 2007; Urdan, 2010).

All four engagement-related variables positively correlated with one another. This indicates that as students engage with one group they also engage with the other groups. All correlations were statistically significant at the $p < .001$ level. The coefficients of determination explained between 1.7% and 17.6% of the variance between the variables.

STEM Aspirations

Students who responded that they had STEM aspirations were placed in the "STEM aspirations" dataset. The data were analyzed using the Pearson correlation on the independent variables associated with engagement: transfer engagement, peer engagement, faculty/staff encouragement/assistance and faculty engagement on coursework. Each engagement variable was analyzed on the remaining three engagement variables creating six independent correlation results. The results of the Pearson correlation for students with STEM aspirations are displayed in Table 4.46.

The variables peer engagement and transfer engagement were analyzed using the Pearson correlation. The correlation indicated that a statistically significant relationship existed between the variables peer engagement and transfer engagement. The correlation coefficient was calculated, $r(971) = .07$, $p < .05$. This positive correlation reveals that students who engaged with their peers on a regular basis also frequently engaged with advisors and counselors in the transfer process. The strength of the relationship is considered to be small (Morgan et al., 2007; Urdan, 2010). The coefficient of determination, r^2, reveals that 0.5% of the variance in peer engagement could be predicted from transfer engagement (Morgan et al., 2007; Urdan, 2010).

The relationship between peer engagement and faculty/staff encouragement/ assistance revealed a statistically significant correlation between the variables. The correlation coefficient was calculated, $r(971) = .30$, $p < .001$. The positive correlation indicates that students who frequently engaged with their peers also received encouragement

Table 4.46

Pearson Correlation of Transfer Engagement, Peer Engagement, Faculty/Staff Encouragement, and Faculty Engagement on Coursework: Students with STEM Aspirations

	Peer engagement	Transfer engagement	Faculty/staff encouragement/ assistance	Faculty engagement on coursework
Peer engagement	—			
Transfer engagement	.065[a]	—		
Faculty/staff encouragement/assistance	.302***	.263***	—	
Faculty engagement on coursework	.377***	.155***	.300***	—

[a]$p = .042$.
***$p < .001$.

or assistance from faculty or staff members on a regular basis. The effect size, *r*, is considered to be small to medium (J. Cohen, 1988; Morgan et al., 2007; Urdan, 2010). The coefficient of determination, r^2, indicates that 9.1% of the variance in peer engagement can be predicted from faculty/staff encouragement/assistance (Morgan et al., 2007; Urdan, 2010).

A Pearson correlation was computed between the variables peer engagement and faculty engagement on coursework. The correlation indicated that statistically significant relationships exist between the variables. The correlation coefficient was calculated, $r(971) = .38$, $p < .001$. The correlation was positive and therefore indicates that as students engaged more often with their peers they also engaged more frequently with faculty on coursework. The strength of the relationship is considered to be moderate (Morgan et al., 2007; Urdan, 2010). The coefficient of determination, r^2, indicates that 14.2% of the variance in peer engagement can be predicted from faculty engagement on coursework (Morgan et al., 2007; Urdan, 2010).

The Pearson correlation of the variables transfer engagement and faculty/staff encouragement/assistance revealed that statistically significant correlations existed between the variables. The correlation coefficient was calculated, $r(971) = .26$, $p < .001$. The positive correlation suggests that students who frequently engaged with counselors and staff members in the transfer process also received encouragement or assistance from faculty or staff members on a regular basis. The effect size, *r*, is considered to be small (J. Cohen, 1988; Morgan et al., 2007; Urdan, 2010). The coefficient of determination, r^2, indicates that 6.9% of the variance in transfer engagement could be predicted from faculty/staff encouragement/assistance (Morgan et al., 2007; Urdan, 2010).

A Pearson correlation was computed between the variables transfer engagement and faculty engagement on coursework and revealed that statistically significant correlations existed between those two variables. The correlation coefficient was calculated, $r(971) = .16$, $p < .001$. This positive correlation reveals that students who engaged in the transfer process on a regular basis also frequently engaged with faculty on coursework. The strength of the relationship is considered to be small (Morgan et al., 2007; Urdan, 2010). The coefficient of determination, r^2, indicates that 2.7% of the variance in transfer engagement can be predicted from faculty engagement on coursework.

A Pearson correlation was computed between the variables faculty/staff encouragement/assistance and faculty engagement on coursework. The correlation coefficient was calculated, $r(971) = .30$, $p < .001$. The correlation was positive and indicates that students who often received encouragement or assistance from faculty or staff members were likely to frequently engage with faculty on coursework. The effect size, *r*, is considered to be small to medium (J. Cohen, 1988, Morgan et al., 2007). The coefficient of determination, r^2, reveals that 9% of the variance in faculty/staff encouragement/assistance could be predicted from faculty engagement on coursework (Morgan et al., 2007; Urdan, 2010).

In summary, the four engagement variables included in the study positively correlated with each other. The positive correlation indicates that as students engaged with one group they also engaged with the other groups. The correlation between peer engagement and transfer engagement was significant at the $p < .05$ level, and all other correlations were statistically significant at the $p < .001$ level. The coefficients of determination explained between 0.5% and 14.2% of the variance between the variables.

The variables associated with engagement were positively correlated for both subgroups of students: students who intended to transfer and students with STEM aspirations. All correlations were statistically significant and positively correlated. The majority of correlations (91.7%) were significant at the $p < .001$ level, and one variable was significant at the $p < .05$ level.

Logistic Regression Analysis

A binary logistic regression analysis was used to analyze the extent to which the independent variables (age, gender, ethnicity, native language, mother's highest level of education, father's highest level of education, level of math completed, level of science completed, concern for finances, marital status, enrollment status, college status, distance of college from permanent home, employment status, number of hours worked for pay weekly, and highest degree earned; Questions 14_10, 15_2, 15_3, 15_5, 15_7, 15_10, 38_1, 38_2, 38_5, 38_6, 40_1, 40_2, 40_5, and 40_6) predicted intention to transfer and STEM aspirations (the dependent variables). Binary logistic regression was chosen for this analysis because of the type of variables in the study. A dichotomous dependent variable coupled with some normal/scale and some dichotomous independent variables is best analyzed through the use of a binary logistic regression analysis. Binary logistic regression was chosen also because of the flexibility of the analysis. Logistic regression does not require the data to meet the general assumptions of normality, linearity, and equal variances (Mertler & Vannatta, 2010; Tabachnick & Fidell, 2007).

In this study, two binary logistic regression analyses were conducted. The first logistic regression focused on the probability of predicting students' intentions to transfer, and the second logistic regression analyzed the probability of predicting students' STEM aspirations. The data were analyzed and interpreted in three sections: goodness-of-fit (χ^2, *df*, *p*, and –2 log likelihood), the accuracy of classification of the model, and a description of the results of the variables included in the model [β, Exp(β)/Odds Ratio, and Wald test]. If the logistic regression produces a negative regression coefficient (β), the Inverse Odds-Ratio (calculated as 1/OddsRatio) will be used to analyze the results (DesJardins, 2001).

Variables included in a logistic regression must be dichotomous or scale, therefore nominal variables had to be recoded. For the logistic regression analysis ethnicity (Question 56) was recoded as URM and non-URM students. Students who indicated that they were White or Asian were coded as being in the non-URM category, whereas all other ethnicities were coded as being in the URM group. The NSF (1991) defined URM as "ethnic groups that are significantly underrepresented at advanced levels of engineering and science, i.e., Blacks, Hispanics, Native Americans, Alaskan Natives, and Native Pacific Islanders" (p. 1). The NSF (2011) later provided a slightly different definition of URM as "three racial/ethnic minority groups (Blacks, Hispanics, and American Indians) whose representation in science and engineering is smaller than their representation in the U.S. population" (p. 13). For the sake of this study, URM was defined as: ethnic minority groups that are significantly underrepresented in STEM-related fields at postsecondary institutions. Underrepresented ethnic groups in STEM fields include: Blacks, Hispanics, Native Americans, Alaskan Natives, and Native Pacific Islanders (NSF, 1991, 2011).

Marital status (Question 58) was recoded into two groups: married and not married. Students who responded that they were currently married were grouped as being in the married category, whereas students who indicated that they were living together (not married); single, never married; or divorced, separated, or widowed were coded as being in the nonmarried group. Employment status (Question 23) was recoded into employed and unemployed groups. Students who indicated that they were currently working on campus or currently working off campus were recoded as being employed, whereas students who responded that they were not working and not looking for work or that they were currently unemployed but looking for work were coded as being in the unemployed category.

Transfer Intentions

The logistic regression to establish the probability that engagement predicts students' intentions to transfer was based on five blocks in the Myers Predictive Model for Community College Students' Intentions to Transfer. The five blocks are shown in Figure 4.7 and include background characteristics, transfer engagement, peer engagement, faculty engagement on coursework, and faculty/staff encouragement/assistance. Each block consists of between two and 17 variables that were entered into the logistic regression analysis using IBM SPSS 20.0 software.

The logistic regression revealed eight statistically significant predictors of students' intention to transfer:

1. Mother's highest level of education
2. Age
3. STEM aspirations
4. Highest desired degree
5. I consulted with academic advisors/counselors regarding transfer
6. I discussed my plans for transferring to a 4-year college or university with an academic advisor/counselor

7. Advisors/counselors identified courses needed to meet the general education/ major requirements of a 4-year college or university I was interested in attending
8. Encouragement or advice from fellow resident or resident assistant.

According to the Hosmer–Lemeshow test and the –2 log likelihood for goodness of fit, the results of the logistic regression indicate that the predictors were statistically reliable in distinguishing between students who intended to transfer and those who did not intend to transfer (–2 log likelihood = 2,701.261, $\chi^2(8) = 19.461$, $p < .05$). The model correctly classified 78% of the cases. The sensitivity indicated that 82.9% of the students who intend to transfer were correctly identified as having transfer intentions. The specificity revealed that 70.5% of the students who do not intend to transfer were correctly identified as not intending to transfer.

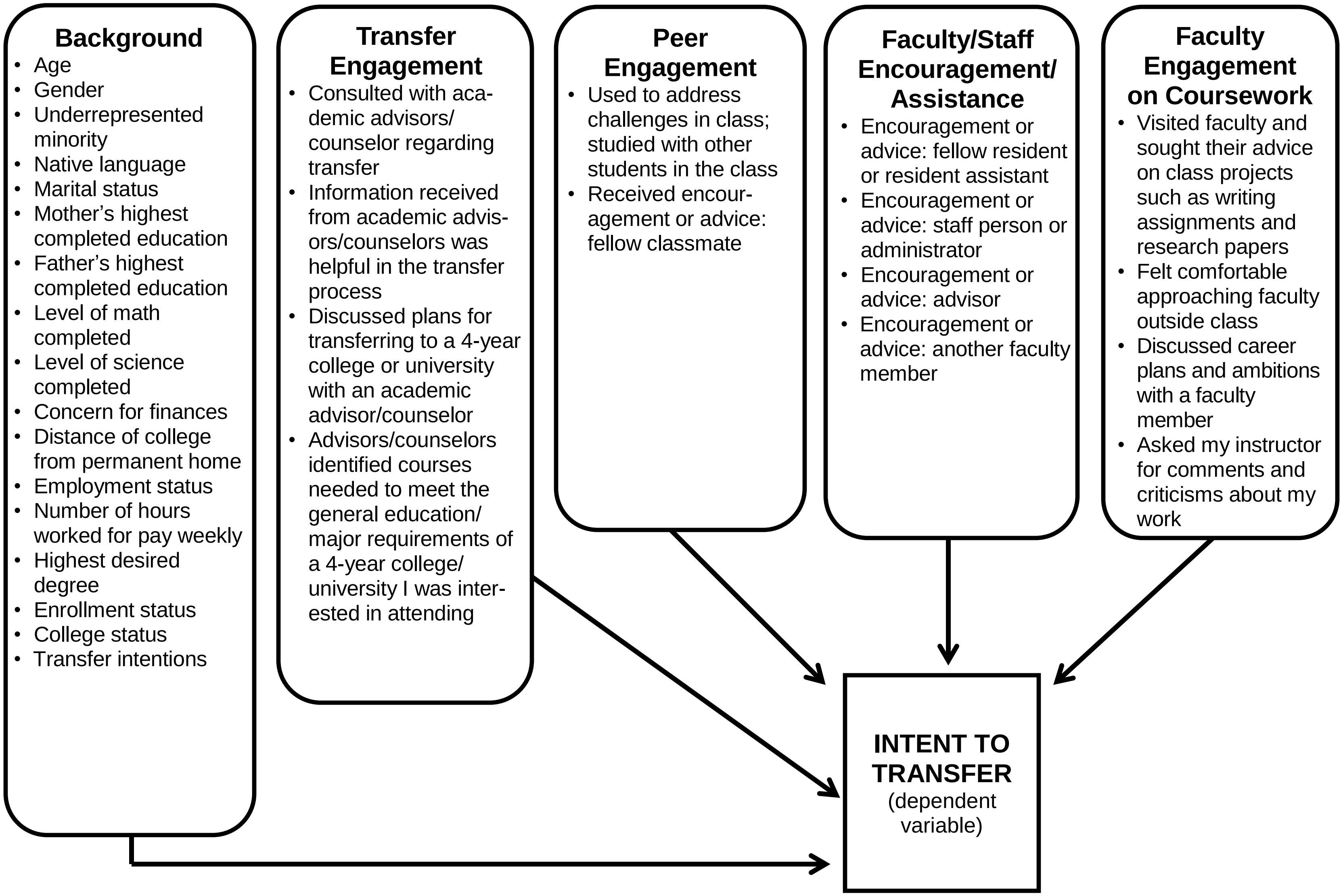

Figure 4.7. Myers' predictive model for community college students' intentions to transfer.

The results of the logistic regression for all predictor variables retained in the model can be found in Table 4.47, and the results of the logistic regression analysis for all variables can be found in Appendix G. STEM aspirations had the highest predictive value ($\beta = 1.472$) of intention to persist. Highest desired degree ($\beta =.532$) also had a high predictive value above $\beta = .500$. Still statistically significant, mother's highest level of education ($\beta = .104$); age ($\beta = -.224$); I consulted with academic advisors/counselors regarding transfer ($\beta = .155$); I discussed my plans for transferring to a 4-year college or university with an academic advisor/counselor ($\beta =.379$); advisors/counselors identified courses needed to meet the general education/major requirements of a 4-year college or university I was interested in attending ($\beta = .102$), and encouragement or advice from fellow resident or resident assistant ($\beta = .150$) had predictive values above $\beta = .100$ and thus also were statistically significant predictors of intention to transfer (Aron et al., 2005; Mertler & Vannatta, 2010).

The variable mother's highest level of education indicated that students whose mothers completed more education responded that they are more likely ($p < .005$) to intend to transfer than did students whose mothers completed very little education. The age variable revealed that younger students were 1.25 times ($p < .005$) more likely to intend to transfer than older students. STEM aspirations indicated that students who indicated that they were planning to major in STEM are 4.36 times ($p < .001$) more likely to intend to transfer than were those students who indicated that they were not planning to major in STEM. The variable highest desired degree revealed that students who desired to complete a higher degree were 1.7 times ($p < .001$) more likely to intend to transfer to a 4-year college or university than were students who did not intend to complete a higher degree. Students who responded that they were more likely to consult with academic advisors/ counselors regarding transfer were 1.17 times ($p < .001$) more likely to have transfer intentions than were those students who did not frequently consult with academic advisors/ counselors on the transfer process.

Table 4.47

Logistic Regression Coefficients - Intention to Transfer

Variable	β	Wald	df	*p*	Odds Ratio
Mother's highest level of completed education	0.104	9.691	1	.002**	1.109
Age	-0.224	8.331	1	.004**	0.799
STEM aspirations	1.472	107.077	1	≤.001***	4.357
Highest desired degree	0.532	184.543	1	≤.001***	1.703
I consulted with academic advisors/counselor regarding transfer	0.155	17.923	1	≤.001***	1.168
I discussed my plans for transferring to a four-year college or university with an academic advisor/counselor	0.379	110.056	1	≤.001***	1.461
Advisors/counselors identified courses needed to meet the general education/major requirements of a four-year college or university I was interested in attending	0.102	11.444	1	≤.001***	1.107
Encouragement or advice from fellow resident or resident assistant	0.150	5.207	1	.022†	1.162
Constant	-3.440	45.825	1	≤.001***	0.032

†$p \leq .05$. **$p \leq .005$. ***$p \leq .001$.

Furthermore, students who indicated that they discussed their plans for transferring to a 4-year institution with an academic advisor/counselor and found those discussions to be more helpful were 1.46 times ($p < .001$) more likely to have transfer aspirations than were students who indicated that discussions about transferring to a 4-year college or university were not helpful. The variable advisors/counselors identified courses needed to meet the general education/major requirements of a 4-year college or university I was interested in attending revealed that students who indicated that meeting with advisors/ counselors about their courses and plans to transfer was more helpful/useful were 1.11 times ($p < .005$) more likely to intend to transfer than were those students who indicated that the meetings with advisors/counselors were less helpful or not useful. Students who indicated that they received encouragement or advice from a fellow resident or resident assistant were 1.7 times ($p < .05$) more likely to have intentions to transfer to a 4-year college or university than were students who did not receive support from a fellow resident or resident advisor.

Thirty-one independent variables were entered into the logistic regression analysis in five blocks and analyzed on the dependent variable intention to transfer. Of the 31 variables entered into the analysis, eight variables were retained into the final model. The results of the chi-square analysis, –2 log likelihood, and Hosmer–Lemeshow test indicate that the model was statistically significantly reliable in distinguishing between students who intend to transfer and those students without transfer intentions.

STEM Aspirations

The logistic regression to establish the probability that engagement predicts students' STEM aspiration was based on five blocks in the Myers Predictive Model for Community College Students' STEM Aspirations. The five blocks are shown in Figure 4.8 and include background characteristics, transfer engagement, peer engagement, faculty engagement on coursework and faculty/staff encouragement/assistance. Each block consists of between two and 17 variables that were entered into the logistic regression analysis using IBM SPSS 20.0 software.

The logistic regression analysis revealed nine statistically significant predictors of students' STEM aspirations:

1. Level of science completed
2. Level of math completed

3. Native language
4. Age
5. Gender
6. Concern for finances
7. Number of hours worked for pay weekly
8. Highest desired degree
9. Intention to transfer.

The variables retained in the logistic regression analysis were statistically reliable in distinguishing between students with STEM aspirations and those students who did not have STEM aspirations (–2 log likelihood = 2,585.492, $\chi^2(8) = 17.025$, $p < .05$). A cut value of .25 revealed that the model correctly identified 69.4% of the cases. The cut value of .25 was utilized for this study as the empirical proportion of successes for students with STEM aspirations is very close to the .25 cutoff. The sensitivity indicated that 63.9% of the students with STEM aspirations were correctly identified as having STEM aspirations. The specificity revealed that 71% of the students without STEM aspirations were correctly identified as not having STEM aspirations.

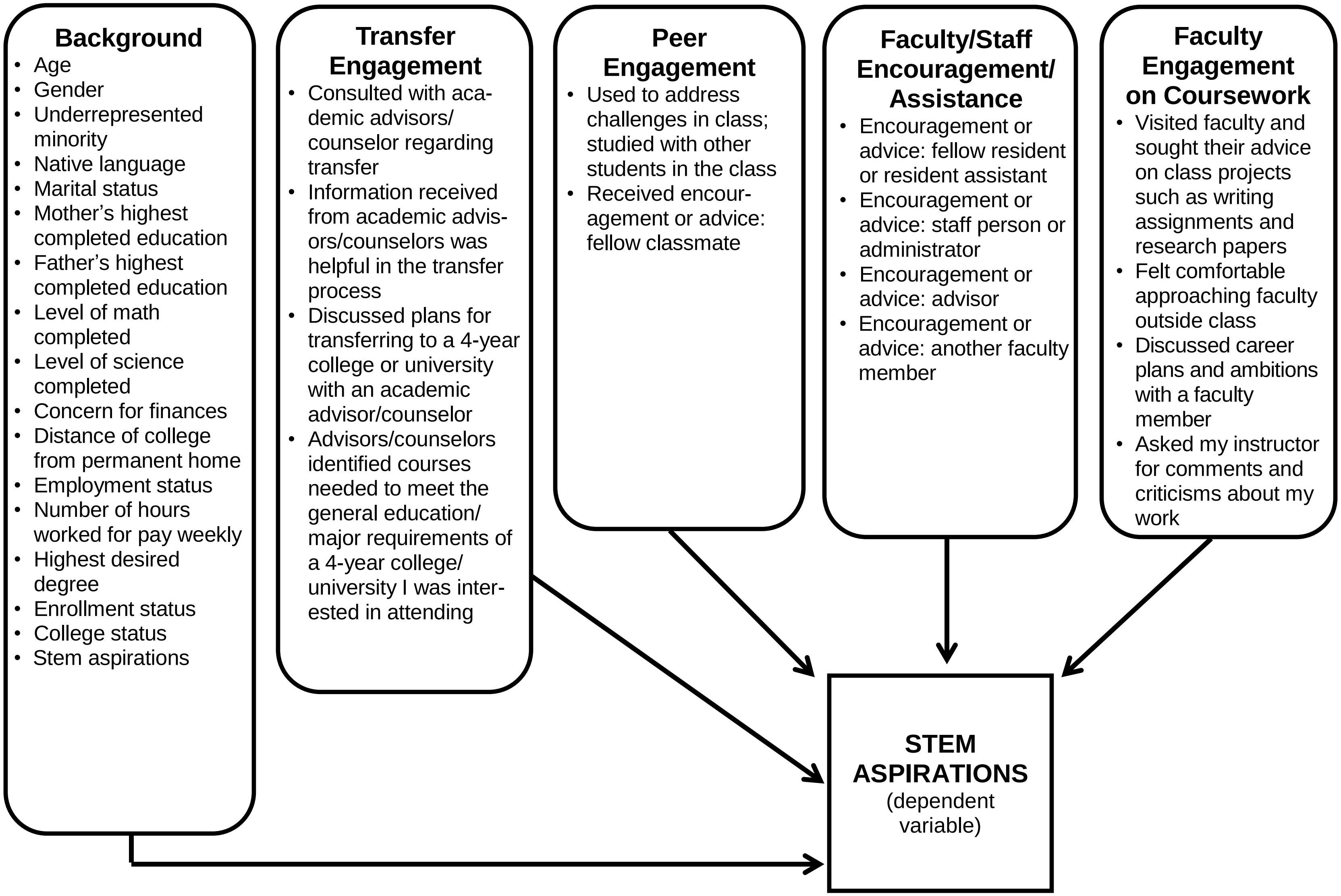

Figure 4.8. Myers' predictive model for community college students' STEM aspirations.

The results of the logistic regression for all predictor variables retained in the model can be found in Table 4.48, whereas the results of the logistic regression analysis for all variables can be found in Appendix H. Intention to transfer had the highest predictive value ($\beta = 1.461$) of STEM aspirations. Level of science completed ($\beta = .561$), native language ($\beta = –.693$), and gender ($\beta = –.527$) also had high predictive values above $\beta = .500$. Still statistically significant, level of math completed ($\beta = .447$), age ($\beta = .249$), concern for finances ($\beta = .154$), number of hours worked for pay weekly ($\beta = –.105$), and highest desired degree ($\beta = .200$) had predictive values above $\beta = .100$ and thus also were statistically significant predictors of STEM aspirations (Aron et al., 2005; Mertler & Vannatta, 2010).

The variable level of science completed indicated that students who completed more science were 1.75 times ($p < .001$) more likely to have STEM aspirations than were students who completed few science courses. Students who indicated that they had completed more math courses were 1.56 times ($p < .001$) more likely to have STEM aspirations than were students who completed few math courses. The variable native language revealed that students whose native language was not English were 2.00 times ($p < .005$) more likely to have STEM aspirations than students who indicated that English was their native language. The age variable indicated that older students were 1.28 times ($p < .005$) more likely to possess STEM aspirations than were younger students. Students who indicated that their gender was male were 1.69 times ($p < .001$) more likely than were female students to respond that they had STEM aspirations. The variable concern for finances indicated that students who are more concerned with financing their education were 1.12 times ($p < .05$) more likely to have STEM aspirations than were those students who had few concerns about financing their education. Students who indicated that they were working very few hours per week were 1.11 times ($p < .01$) more likely to have STEM aspirations than were students who were working frequently at a job for pay. The variable highest desired degree revealed that students who would like to complete a higher degree were 1.22 times ($p < .001$) more likely to have STEM aspirations than were students who did not intend to complete a higher degree. Students who indicated that they had transfer intentions are 4.31 ($p = .001$) times more likely to have STEM aspirations than were those students who did not intend to transfer.

Table 4.48

Logistic Regression Coefficients: STEM Aspirations

Variable	β	Wald	*df*	*p*	Odds ratio
Level of science completed	0.561	31.197	1	≤.001***	1.753
Level of math completed	0.447	16.391	1	≤.001***	1.564
Native language	-0.693	9.373	1	0.002**	0.500
Age	0.249	8.845	1	0.003**	1.283
Gender	-0.527	23.864	1	≤.001***	0.590
Concern for finances	0.154	4.217	1	0.040†	1.116
Number of hours worked for pay weekly	-0.105	7.681	1	0.006*	0.901
Highest desired degree	0.200	22.910	1	≤.001***	1.221
Intention to transfer	1.461	111.519	1	≤.001***	4.310
Constant	-4.417	78.245	1	≤.001***	0.012

†$p \leq .05$. *$p \leq .01$. **$p \leq .005$. ***$p \leq .001$.

Thirty-one independent variables were entered into the logistic regression analysis in five blocks and analyzed on the dependent variable intention to transfer. Of the 31 variables entered into the analysis, nine variables were retained into the final model. The results of the chi-square analysis, –2 log likelihood, and Hosmer–Lemeshow test indicate that the model was statistically significantly reliable in distinguishing between students with STEM aspirations and those students without STEM aspirations.

Summary

This chapter includes descriptive, between groups, construct measurement, correlation, and prediction analyses of all students in the SSSL dataset, students who intended to transfer to a 4-year college or university, and those students who had STEM aspirations. The types of analyses include frequency, cross-tabulations and Pearson chi-square, Mann-Whitney U, independent samples *t*-test, exploratory factor analysis, confirmatory factor analysis, Pearson correlation, and logistic regression analysis. All data analyses were conducted using IBM SPSS 20.0 and AMOS 20.0 software.

The findings of the data analysis were presented in five sections, the first four corresponding with the first four research questions that guided this study and a fifth section comprising the findings relating to the final two research questions. The first section presented the results of the demographic descriptive statistics for each of three groups of students: (a) all students (every student who responded to the SSSL survey), (b) the intention to transfer group (all students who indicated that they intended to transfer to a 4-year college or university, and (c) the STEM aspirations group (all students who responded that they intended to major in a STEM-related field).

The second section included the findings of the exploratory and confirmatory factor analyses. The exploratory factor analysis produced four constructs (Peer Engagement, Transfer Engagement, Faculty/Staff Encouragement/Assistance, and Faculty Engagement on Coursework) of student engagement that included 18 factors associated with engagement. The four constructs and all corresponding factors were then entered into a confirmatory factor analysis using AMOS 20.0. Multiple analyses were conducted and the final community college student engagement model retained the four constructs produced in the exploratory factor analysis, but included only 14 of the original 18 factors. This final model produced good model fit compared to the benchmarks established in this study.

The third section of this chapter reported the findings of the between-groups analysis for the independent variables: age, gender, ethnicity, native language, mother's highest level of completed education, father's highest level of completed education, level of math completed, level of science completed, concern for finances, marital status, distance of college from permanent home, highest desired degree, employment status, number of hours worked for pay weekly, enrollment status, and college status. The comparative analysis was conducted based on both dependent variables: intention to transfer and STEM aspirations. The comparative analysis indicated that statistically significant differences existed between students who intended to transfer and students who did not intend to transfer on the following variables: age, concern for finances, ethnicity, gender, native language, marital status, mother's highest level of completed education, father's highest level of completed education, enrollment status, college status, level of math completed, level of science completed, highest desired degree, and transfer engagement. The results of the independent samples *t*-test, cross-tabulations, Pearson chi-square analysis, and Mann-Whitney U tests revealed that statistically significant differences existed between students with STEM aspirations and those without STEM aspirations for the following variables: highest desired degree, ethnicity, gender, native language, mother's highest level of completed education, father's highest level of completed education, enrollment status, level of math completed, level of science completed and concern for finances, transfer engagement, peer engagement, faculty/staff encouragement/assistance, and faculty engagement on coursework.

The fourth section in this chapter revealed the results of the correlation analysis through the use of three Pearson correlations. Two Pearson correlations were conducted using the following engagement variables: peer engagement, transfer engagement, faculty/staff encouragement/assistance, and faculty engagement on coursework. The Pearson correlations were conducted using the three student groups: all students, intention to transfer group, and STEM aspirations group. All three correlation analyses indicated that positive correlations did exist between the engagement variables. All correlations were significant at the $p \leq .05$ level, and the majority (97.2%) of correlations were significant at the $p \leq .001$ level.

The fifth section reported the results for the logistic regression analysis for the dependent variables intention to transfer and STEM aspirations. Demographic and engagement variables were entered into the binary logistic regression analysis in five blocks. For intention to transfer, variables that were significant at the $p \leq .05$ level were retained in the model and were significant predictors of students' intentions to transfer were: mother's highest level of completed education, age, stem aspirations, highest desired degree, I consulted with academic advisors/counselors regarding transfer, I discussed my plans for transferring to a 4-year college or university with an academic advisor/counselor, advisors/counselors identified courses needed to meet the general education/major requirements of a 4-year college or university I was interested in attending, and encouragement or advice from fellow resident or resident assistant. For STEM aspirations, variables that produced statistically significant results at the $p \leq .05$ level were retained in the model as predictors of students' STEM aspirations. Variables retained in the STEM aspirations model were the following: level of science completed, level of math completed, native language, age, gender, concern for finances, number of hours worked for pay weekly, highest desired degree, and transfer intentions.

The results of the analyses conducted in Chapter 4 are further discussed in Chapter 5. A discussion of the implications of the results; recommendations for policy, practice, and future research; and conclusions of the study can also be found in Chapter 5.

CHAPTER 5. DISCUSSION, CONCLUSIONS, AND IMPLICATIONS

Introduction

The United States and the state of Iowa have begun to refocus their educational goals and objectives to return the United States to the role of a world leader in education and, more specifically, in the education of students in STEM-related fields. Recent studies have shown that the United States now lags behind other nations in the number of college graduates and graduates in STEM majors. The federal and state governments are taking note and developing and implementing strategies to begin to return our nation's educational system to the world-wide competitive level it once held (Kuenzi, 2008).

Unfortunately, as more jobs are being created in STEM-related fields, the number of students in STEM fields graduating from colleges in the United States has not followed suit. In the nearly 40-year period between 1971 and 2010, there was no increase in the percentage of undergraduate students who indicated that they intended to major in a STEM-related field (Hurtado et al., 2010). Although the number of students intending to major in STEM fields has stayed stagnant, the number of STEM students beginning their education at community colleges has continued to increase. In 2011, two studies reported that nearly half of all STEM graduates, especially those in science, engineering, and health fields, completed at least one course at a community college (Mooney & Foley, 2011; Reyes, 2011).

The cost of college tuition is rising at the same time that an increasing number of jobs are requiring postsecondary education. The lower cost of a community college education, coupled with community colleges' ability to quickly retrain workers, has led to an increase in the number of students enrolling in community colleges. Students completing associate's degrees at 2-year colleges rose by more than 50% between the 1999–2000 and 2009–10 academic years, thus indicating that students truly are looking toward the community colleges as competitive and cost-efficient institutions at which to begin their postsecondary education (NCES, 2012).

Policymakers and college administrators across the nation are working to increase the number of college graduates, especially graduates in STEM-related fields. With the creation of the Iowa Mathematics and Science Education Partnership, the Iowa STEM Education Roadmap and, most recently in July 2011, the Iowa Governor's STEM Advisory Council, the state of Iowa has followed suit and begun to refocus its resources on improving STEM education.

All students today, especially those attending community colleges, are faced with outside factors that influence their educational choices and outcomes. A number of outside influences (i.e., work obligations, financial concerns, family responsibilities, and learning disabilities) impact students' educational experiences. Likewise, the experiences that students have while attending college influence their educational goals and outcomes. Much research has been conducted on the role of student engagement on students' educational experiences and outcomes. However, very little research has been done on the influence of engagement on students' educational outcomes at the community college level.

A review of the literature surrounding STEM education, community college completion, and student engagement led to the development of the six research questions that guided this study:

1. What are the demographic and background characteristics of students in the SSSL study, students who intend to transfer to a 4-year institution and students who have STEM aspirations?

2. How are student engagement constructs measured by variables in the SSSL survey?
3. Are there statistically significant differences between students who intend to transfer and students without transfer intentions, or between students with STEM aspirations and students without STEM aspirations, based on their demographic characteristics?
4. Is there a correlation between engagement variables among students who intend to transfer or students with STEM aspirations?
5. To what extent do student demographics and student engagement levels predict students' intention to transfer?
6. To what extent do student demographics and student engagement levels predict students' STEM aspirations?

This chapter discusses the results of the analyses conducted using the SSSL data that were obtained in a survey of students in the 15 Iowa community college districts. The data are discussed with regard to the two dependent variables: intention to transfer and STEM aspirations. This chapter also includes recommendations for policy and practice as well as suggestions for future research and closes with conclusions of the study.

Discussion of Results

This section provides a discussion of the results of the descriptive analysis, factor analysis, comparative analysis, correlation analysis, and logistic regression analysis. Results are discussed for the dependent variables intention to transfer and STEM aspirations. The data were quantitatively analyzed using IBM SPSS 20.0 and AMOS 20.0 software.

Descriptive Analysis

The results of the descriptive analysis were calculated using frequency statistics. The descriptive analysis was conducted on all students who responded to the SSSL survey, students who indicated they intended to transfer to a 4-year college or university, and students who responded that they had STEM aspirations. The results indicate that the students in each group responded similarly to questions regarding their background and demographic characteristics.

In all three groups, the largest percentage of students were female and traditional age (18–24 years old), White/Caucasian, native English speakers, single/never married, employed off campus, and working more than 30 hours per week. In general, these results are indicative of the college population in Iowa, especially those attending the state's community colleges. The percentage of females in the sample was slightly higher than the average for the state of Iowa (72.7% and 55%, respectively), but research indicates that females are more likely than are males to respond to survey requests (Iowa Department of Education, 2011).

Students in the three groups also responded similarly to questions regarding their parents' highest level of completed education. The majority of students indicated that both their mothers and fathers had completed a high school diploma as their highest level of completed education. Some college, associate's degree from a 2-year college, and bachelor's degree also each accounted for more than 10% of the responses for all three groups of students.

The majority of students in all three research groups indicated that they had completed six or fewer math courses and four or fewer science courses, placing them in the low math and low science groups, respectively. However, students who indicated they had STEM aspirations responded that they had completed five to eight science courses (44.8%) and seven to 12 math courses (35%) at higher rates than did students in any of the other two groups (29.4% of all students and 36.1% of students intending to transfer having completed five to eight science courses; 21.2% of all students and 26.8% of students intending to transfer having completed seven to 12 math courses).

An overwhelming majority of students (more than 85% for all three groups) indicated that their permanent home was 5–50 miles from the college that they were currently attending. This is representative of the community college students in Iowa, in that 92% of students attending Iowa's community colleges are residents of Iowa (Iowa Department of Education, 2011).

The majority of students in all three research groups also indicated that they were enrolled on a full-time basis and that the Fall 2012 semester was not their first semester enrolled in college. The largest percentage of students (30.1%) who indicated that they were enrolled on a part-time basis came from the all-students group. Students who indicated that they intended to transfer made up the largest percentage of students who were enrolled in their first semester of college (16.3%).

Students in all three groups indicated that they intended to complete at least a bachelor's degree and maybe more as their highest desired academic degree. Students in the all students and the intention to transfer groups indicated that they intended to complete a master's degree as the second highest percentage response, whereas students in the STEM group responded as the second highest percentage response that they intended to complete a doctoral degree.

Of the students who indicated that they intended to major in a STEM field, the highest percentage responded that they were planning to major in a health-related field. The next largest percentage of students in all three groups indicated that they intend to major in engineering. The very large percentage of students who intended to major in health-related fields (43.8%) is representative of the large proportion of nursing and allied-health students attending Iowa community colleges.

More than half of students in all three groups responded that they had at least some concern for financing their education. Students who indicated that they had STEM aspirations had the highest percentage of students who had major concerns about finances (28.3%, compared to 24.7% for all students and 27.1% for students intending to transfer). Current literature has suggested that students majoring in STEM-related fields may incur more debt than their non-STEM peers, and the influence of financial assistance and scholarships can positively affect STEM students' completion rates (Whalen & Shelley, 2010).

Students in all three groups responded similarly to the variable peer engagement. More than 30% of the students in all three groups indicated that they used or received peer engagement and that it was somewhat helpful. However, students in all three groups also indicated that they used or received peer engagement and that it was not helpful or that they did not use or receive peer engagement. Less than 12% of students in all three groups indicated that peer engagement was very helpful.

The largest percentage of students in all three groups responded that they did not use or receive encouragement or assistance from a faculty or staff member. The next largest percentage of students in all three groups indicated that they used or received encouragement/assistance and that it was not helpful. This indicates that students are either not interacting at all or not positively interacting with faculty and staff members.

Students in all three groups responded similarly to the variable faculty engagement on coursework. The highest percentage of students indicated that they engaged with faculty about coursework a few times per semester. The next largest percentage of students in all three groups indicated that they engaged with faculty on coursework once a month. These results indicate that students are engaging with faculty members outside of the classroom environment but could engage with faculty on a more regular basis.

The descriptive analysis revealed that there were a few variables for which the three groups of students responded at different rates. The majority of students in the SSSL all student data group as well as the intention to transfer group indicated that they did not intend to major in a STEM-related field; as expected all students in the STEM aspirations group intended to major in a STEM field. More than one in five (22.2%) students indicated that they had STEM aspirations, which is slightly higher than the 16.6% of degrees and certificates awarded to Iowa community college students in STEM fields for the 2009–10 academic year (IMSEP, 2009).

Students in the three groups responded quite differently to the engagement construct Transfer Engagement. The largest percentage (22.4%) of students in the all students group indicated that they disagreed that they utilized transfer engagement. Likewise, 19.6% of students in the transfer intentions group indicated that they agreed that they used transfer engagement, and 18.6% of those in the STEM aspirations group slightly agreed that they utilized transfer engagement. This indicates that the students who are more likely to transfer or to have STEM aspirations are more likely to utilize the services provided by academic advisors/counselors.

Factor Analysis

The exploratory factor analysis produced four engagement constructs: Peer Engagement, Transfer Engagement, Faculty/Staff Encouragement/Assistance and Faculty Engagement on Coursework. The four constructs each consisted of three to six variables with factor loadings between .500 and .844. The constructs produced alpha reliability coefficients between .691 and .834. The four engagement constructs were then entered into a confirmatory factor analysis.

The confirmatory factor analysis was run using AMOS 20.0 software. The confirmatory factor analysis produced a community college student engagement model indicating that the model has very good fit, a $\chi^2/df = 1.777$, CFI = 0.998, GFI = 0.997, and RMSEA = 0.012, $p < .001$. Inter- and intra-construct covariances were established, and four variables were removed from the exploratory factor analysis, but the four previously established engagement constructs were retained. Factor loadings retained in the confirmatory factor analysis ranged from .52 to .79. The final four constructs in the community college student engagement model consisted of two to four variables each associated with engagement.

The results of the factor analyses differed slightly from the constructs produced through research conducted at the CCCSE. The CCSSE focuses on five constructs: Active and Collaborative Learning, Student Effort, Academic Challenge, Student–Faculty Interaction, and Support for Learners (McClenney, 2006). The constructs produced in the present study (using the SSSL survey) are similar to those produced through the CCSSE.

The SSSL construct Faculty Engagement on Coursework is similar to the CCSSE construct of Student–Faculty Interaction. Both constructs focus on student–faculty engagement outside of the normal classroom environment. Similarities between the constructs include discussing coursework and assignments with instructors, working collaboratively with instructors, and receiving feedback on coursework.

The SSSL construct Faculty/Staff Encouragement/Assistance is relatable to the CCSSE construct Support for Learners, because both focus on the interaction between students who are in need of assistance and staff members who may be able to provide the desired type of assistance. The two constructs differ, though, because the CCSSE construct focuses on academic tutoring and assistance, whereas the SSSL construct focuses more on providing encouragement and advice on how students can succeed in their most challenging class.

The SSSL construct Peer Engagement could be compared to the CCSSE construct Active and Collaborative Learning, because both constructs focus on student–student interactions. The CCSSE construct focuses on engagement with peers within the learning environment as well as on in-class participation and involvement in community service activities. The SSSL construct focuses on the interaction with peers to assist with studying for courses and on seeking encouragement from peers when students are struggling with coursework.

The SSSL construct Transfer Engagement stands alone from the constructs developed by the CCSSE. Transfer Engagement focuses on the interactions students have with academic advisors and counselors throughout their academic career. These interactions can include meetings to discuss future transfer plans, discussions about current academic coursework, and regularly meeting with advisors or counselors.

Comparative Analysis

Cross-tabulations, Pearson chi-square analyses, Mann-Whitney U tests, and independent samples *t*-tests were used to analyze the between-groups differences of the independent variables. The tests were conducted for each variable for each of the two subsamples: intention to transfer and STEM aspirations. The tests were conducted on each of the subsamples to determine if statistically significant differences exist between students with transfer intentions and students who do not intend to transfer or between students with STEM aspirations and those students without STEM Aspirations.

Intention to transfer. Cross tabulations and Pearson chi-square analyses, independent samples *t*-tests, and Mann-Whitney U tests were used to analyze the differences between students who intended to transfer and those students who did not intend to transfer on the independent variables associated with student demographics and student engagement. The analyses indicated that ethnicity, gender, native language, marital status, mother's highest level of education, father's highest level of education, enrollment status, college status, transfer engagement, level of math completed, level of science completed, highest desired degree, age, and concern about finances revealed statistically significant differences between students who intend to transfer and those who do not intend to transfer.

The results of the cross-tabulations and Pearson chi-square analyses indicated that students who are more likely to intend to transfer are American Indian/Alaskan Native, Asian, Black/African American, or Hispanic; female; nonnative English speakers; and single, never married. Students who are more likely to intend to transfer have mothers who completed elementary school or less, some college, an associate's degree, a bachelor's degree, some graduate school, or a graduate degree as their highest level of completed education and have fathers who completed some college, an associate's degree, a bachelor's degree, some graduate school, or a graduate degree as their highest level of completed education. Students who are enroll in college on a full-time basis and students who are enrolled in their first semester of college are more likely than expected to intend to transfer. Students who more likely to intend to transfer slightly agree, agree, or strongly agree that they engage with advisors/counselors in the transfer process.

The Mann-Whitney U test for the level of math completed variable revealed that students who intended to transfer had a higher mean rank than did students who did not intend to transfer, indicating that students with transfer intentions complete more math courses than have students without transfer intentions. Level of science completed produced similar results, indicating that students who intend to transfer have completed more science courses than have students without transfer intentions. The results for the variable highest desired degree indicated that students intending to transfer had a higher mean rank than did students who did not intend to transfer, indicating that students who intend to transfer seek to complete a higher degree than do those students without transfer intentions.

The independent samples *t*-test revealed that statistically significant differences exist between students who intend to transfer and those students without transfer intentions with regard to age. The results indicate that students intending to transfer have a lower mean age than do students not intending to transfer. The analysis of the concern for finances variable indicates that students with and without transfer intentions differ significantly. The results reveal that students who intend to transfer have a higher mean concern about finances, indicating that students who intend to transfer are more concerned with how they plan to finance their education than are students who do not intend to transfer.

This study produced results similar to previous research studies conducted on students' educational outcomes and transfer intentions. Laanan (2003) noted that age, parents level of education, ethnicity, gender, academic preparation, and academic goals influence students' educational outcomes. His study found that younger, female, non-White students who have parents who completed more education, have set high academic goals, and have academically prepared themselves are more likely to intend to transfer to a 4-year college or university. Astin (1993) and Pascarella and Terenzini (2005) also found that demographic characteristics largely influence students' educational outcomes, especially when focusing on academic preparation and parental education. Pascarella and Terenzini (2005) also noted that students' ability to pay negatively impacts their educational outcomes. Students who are unsure about their ability to finance their current or future education are less likely to fulfill their intended degree plans, or in the case of this study, to intend to transfer to a 4-year college or university.

The comparative analysis revealed that students who intend to transfer and students who do not intend to transfer do not differ significantly on the following variables: peer engagement, faculty/staff encouragement/assistance, faculty engagement on coursework, distance of college from permanent home and hours worked for pay weekly.

These results differ significantly from the findings presented by Astin (1993) in *What Matters in College: Four Critical Years Revisited*. The majority of Astin's (1993) study was based on the premise that engagement positively influences student outcomes, found that student–student interactions, including peer study groups, tutoring, and class discussions, positively influenced students' educational outcomes. The study also noted that "student–faculty interaction has significant positive correlations with every academic attainment outcome: college GPA, degree attainment, graduating with honors, and enrolling in graduate or professional school" (Astin, 1993, p. 383). Kuh et al. (2010) also discussed the positive aspects of student–faculty engagement on students' educational attainment and found that colleges that encourage interactions between students and faculty members retain and graduate their students at higher rates than do many other colleges. Astin (1993) indicated that the number of hours students spend working at a job for pay negatively influences their educational outcomes. Students who have to spend a large portion of their day working at a job have less time to devote to studying and often feel that they cannot juggle college and work. This often results in some students dropping out and failing to attain their educational goals.

STEM aspirations. Cross-tabulations and Pearson chi-square analyses, independent samples *t*-tests and Mann-Whitney U tests were used to analyze the differences between students who have STEM aspirations and those students without STEM aspirations on the independent variables associated with student demographics and student engagement. The analysis revealed that ethnicity, gender, native language, mother's highest level of education, father's highest level of education, transfer engagement, peer engagement, faculty/staff encouragement/assistance, faculty engagement on coursework, level of math completed, level of science completed, concern for finances and highest desired degree differed significantly between students with STEM aspirations and those without STEM aspirations.

The cross-tabulations and Pearson chi-square test revealed that students who are more likely than expected to have STEM aspirations are American/Indian/Alaskan Native, Asian, Black/African American, or Hispanic; male; nonnative English-speaking students. Students whose mothers completed elementary school or less, some college, an associate's degree, a bachelor's degree, some graduate school, or a graduate degree as her highest degree and students whose fathers completed high school, some college, an associate's degree, a bachelor's degree, some graduate school, or a graduate degree as his highest level of education are more likely than expected to have STEM aspirations.

Students who have STEM aspirations are more likely than expected to be enrolled in college on a full-time basis. Transfer Engagement revealed that students who indicate that they slightly agree, agree, or strongly agree about their interactions with counselors and advisors are more likely than expected to have STEM aspirations. Students who respond that peer engagement is not helpful, somewhat helpful, or very helpful are more likely than expected to have STEM aspirations. Students with STEM aspirations are polarized on the engagement variable faculty/staff encouragement/assistance. Students who indicate that encouragement or assistance from faculty or staff members was not helpful or very helpful are more likely than expected to have STEM aspirations. Students who are more likely than expected to have STEM aspirations engage with faculty more frequently outside of the classroom. Students who indicate that they engage with faculty members once a month, several times per month, or several times per week were more likely than expected to have STEM aspirations.

The Mann-Whitney U test for the variable level of math completed revealed that students with STEM aspirations have a higher mean rank than do students who do not intend to major in a STEM-related field, indicating that students with STEM aspirations have completed more math courses than students without STEM aspirations. The level of science completed variable produced similar results, indicating that students with STEM aspirations complete more science courses than do students without STEM aspirations. The results for the variable financial concerns indicate that students with STEM aspirations have a higher mean rank than do students without STEM aspirations, indicating that students who intend to major in a STEM field are more concerned about financing their education than are students without STEM aspirations.

The independent samples *t*-test results reveal that highest desired degree variable was statistically significant, indicating a significant difference exists between the means of students who have STEM aspirations and those students without STEM aspirations. This reveals that students who have STEM aspirations desire to complete a higher degree than do students who indicated that they do not have STEM aspirations.

These findings are largely indicative of the findings of previous research on STEM education. Chen (2009) indicated that students who enrolled in STEM fields between the years of 1995 and 2001 were more likely to be male, non-native English speakers, who had parents who had completed higher levels of education, who had completed higher level courses in both math and science, and who expected to complete higher postsecondary degrees upon enrolling in college.

Little research has been conducted on the influence of engagement on community college students' STEM aspirations, but a research brief produced by the Iowa State University Office of Community College Research & Policy indicated that students who had transferred from community colleges into the College of Engineering at Iowa State University were positively influenced by transfer engagement and academic advising/ counseling. The students in the Student Enrollment and Engagement through Connections

(SEEC) study indicated that they somewhat agreed or strongly agreed at or above the 60% level on most factors influencing transfer engagement (i.e., consulting with academic advisors/counselors regarding transfer, receiving information about the transfer process, discussing plans for transfer, and identifying courses needed to meet educational goals; Laanan et al., 2010).

The comparative analyses revealed that students with STEM aspirations and those without STEM aspirations do not significantly differ on the following variables: marital status, college status, distance of college from permanent home, age and hours worked for pay weekly.

Although this study's results indicate that age does not relate to significant differences between students with STEM aspirations and those without STEM aspirations, several other studies have found significant differences among age groups. Chen's (2009) study and the SEEC data brief (Laanan et al., 2010) indicated that younger students are more likely to have STEM aspirations than are older students. The SEEC study found that 55.1% of students who had transferred from community colleges into the College of Engineering at Iowa State University were 19–22 years of age and an additional 34.4% were between the ages of 23 and 27 (Laanan et al., 2010).

Correlation Analysis

Two Pearson correlations were utilized to study the correlations (if any) between the independent variables associated with engagement: peer engagement, transfer engagement, faculty/staff encouragement/assistance, and faculty engagement on coursework. The Pearson correlations were conducted on the subsample of students who intended to transfer (n = 2,707) and the students who had STEM aspirations (n = 1,040). The results indicated that statistically significant correlations exist between all engagement variables for both subsamples of students. All engagement constructs in the intention to transfer subsample correlated significantly at the $p < .001$ level, while all engagement constructs in the STEM aspirations subsample correlated significantly at the $p < .05$ level.

The results of the Pearson correlations are similar to Astin's (1993) findings that suggest that students who engage with one group on campus are more likely to engage with other groups on campus. He indicated that, once students become involved on campus, they are likely to make friends who are also involved and, therefore, will attend more events and become even more engaged in the college setting. Astin's (1993) study found that engaging with peers often negatively correlates with transfer engagement, but this study revealed a positive correlation between all engagement variables.

Logistic Regression Analysis

Two logistic regression analyses were conducted using 31 independent variables on the dependent variables intention to transfer and STEM aspirations. The variables were entered into the logistic regression in five blocks: background characteristics, peer engagement, transfer engagement, faculty/staff encouragement/assistance, and faculty engagement on coursework.

Intention to transfer. The logistic regression analysis on the dependent variable intention to transfer retained eight variables in the community college student engagement model: mother's highest level of completed education; age; STEM aspirations; highest desired degree; I consulted with academic advisors/counselors regarding transfer; I discussed my plans for transferring to a 4-year college or university with an academic advisor/counselors; advisors/counselors identified courses needed to meet the general education/major requirements of a 4-year college or university I was interested in attending, and encouragement of advice from fellow resident or resident assistant. This indicates that student demographics play a large role in predicting students' intentions to transfer, but variables associated with transfer engagement and faculty/staff encouragement/assistance also influence students' transfer intentions. In this study, students whose parents completed higher levels of education, have STEM aspirations, desire to complete a higher degree, and are traditional age are more likely to intend to transfer.

The results of the study indicated that mother's highest level of completed education positively influences students' transfer intentions. This indicates that students whose mothers completed more education are more likely to intend to transfer than are those whose mothers completed lower levels of education. The age variable is a negative predictor of students' intentions to transfer. This reveals that younger students are more likely to intend to transfer than are older students. STEM aspirations positively influence students' intentions to transfer and indicates that students with STEM aspirations are more likely to intend to transfer than are students without STEM aspirations. The highest desired degree variable is a positive influence of students' intentions to transfer. This indicates that students who desire to complete higher postsecondary degrees are more likely to intend to transfer than are students who do not seek to complete higher academic degrees.

Astin (1993) and Pascarella and Terenzini (1991, 2005) noted that students' background characteristics play a large role in their educational outcomes. Bright students, from upper-middle class families, whose parents are actively involved in their lives are often more likely than are other students to have high academic aspirations. Laanan (2003) found similar results in his study of the variables associated with predicting community college students' degree aspirations. In that study, he found that mother's highest level of education and age predicted students' highest degree aspirations. As in this study, Laanan (2003) found that age was a negative predictor of student outcomes. Age as a negative predictor indicates that younger students are more likely to have higher degree aspirations than are older students.

The relationships students develop with academic advisors/counselors and the time they spend discussing their academic goals with them can influence students' transfer intentions. The questions that showed a positive influence in students' transfer intentions were focused on meeting with academic advisors/counselors specifically on the transfer process. The questions include: consulting with advisors/counselors about transferring, discussing plans for transferring with an academic advisor/counselor, and advisors/ counselors identified courses needed to meet the requirements at a 4-year institution. These results suggest that students who already intend to transfer to a 4-year institution have had positive engagement experiences with academic advisors/counselors regarding their plans for transferring.

One faculty/staff encouragement/assistance question showed a positive influence on students' intentions to transfer. Receiving "encouragement or advice from fellow resident or resident assistant" positively influences students' transfer intentions. This indicates that students who feel they can talk to a fellow resident or resident assistant about their problems are more likely to have transfer intentions. Students who feel they have a positive social network often feel they are more capable of accomplishing goals than do students who feel alone in their life and academic pursuits.

The results of the logistic regression on the engagement variables are similar to findings in previous research studies by Astin (1993), Pascarella and Terenzini (1991, 2005), and Kuh et al. (2005). The findings of these studies indicated that, in general, the presence of engagement in students' lives leads to attainment of educational goals, which for this study is classified as intention to transfer. The studies also found that positive predictive relationships exist between most variables associated with engagement and students' intentions to transfer.

The findings of the logistic regression analysis for the dependent variable intention to transfer indicated that there is a statistically significant relationship between engagement and students' intention to transfer to a 4-year college or university and resulted in the rejection of the first null hypothesis (H_0^1).

STEM aspirations. The logistic regression analysis on the dependent variable STEM aspirations retained nine variables in the community college student engagement model: level of science completed, level of math completed, native language, age, gender, concern for finances, number of hours worked for pay weekly, highest desired degree, and intention to transfer. These results suggest that students' STEM aspirations are influenced more by background and demographic characteristics than by engagement.

The variables level of science completed and level of math completed have positive influences on students' STEM aspirations. This indicates that the more courses students take in math and science, the more likely they are to have STEM aspirations. The native language variable is a negative predictor of STEM aspirations, indicating that students who are nonnative English speakers are more likely to have STEM aspirations than are native English-speaking students. Age is a positive influence on student engagement, suggesting that older community college students are more likely to have STEM aspirations than are younger students. The gender variable revealed a negative influence on students' STEM aspirations. This indicates that male students are more likely to have STEM aspirations than are female students. The variable concern for finances is a positive influence on student engagement, suggesting that students with STEM aspirations are more concerned about financing their education than are students without STEM aspirations. Number of hours working for pay weekly revealed a negative influence on STEM aspirations, indicating that students who spend more hours working are less likely to have STEM aspirations than are students who work a minimal number of hours each week. The highest desired degree variable positively influenced STEM aspirations. This indicates that as students' postsecondary degree aspirations increase, so do their STEM aspirations. Intention to transfer positively influences students' STEM aspirations, suggesting that students who intend to transfer to a 4-year college or university are more likely to have STEM aspirations than are students who do not intend to transfer.

The results of the logistic regression analysis for STEM aspirations confirmed what previous literature suggested: that male students, whose native language is not English, who excel in science and math, and have high degree aspirations are more likely to have STEM aspirations (Chen, 2009; Laanan et al., 2010).

The results of the logistic regression analysis for the dependent variable STEM aspirations, indicating that there is no statistically significant relationship between engagement and students' STEM aspirations, resulted in the retention of the second null hypothesis (H_0^2).

Summary

This study proved that engagement, especially in terms of transfer engagement and faculty/staff encouragement/assistance positive influences students transfer intentions. Students' background characteristics will continue to influence students' educational and career choices, but encouraging positive engagement opportunities between students and community college staff and faculty members can positively influence students' educational goals and increase the number of students' transferring to four-year institutions. While this study proves that engagement does positively predict students' transfer intentions, there is still room to improve in terms students engaging with faculty members on coursework.

This study also proved that student demographic and background characteristics play a large role in influencing students' STEM aspirations, while engagement does not predict students' STEM aspirations. This study is congruent with current literature suggesting that students' whose parents are more education and have completed higher levels of math and science are more likely to pursue STEM careers (Chen, 2009; Laanan et al., 2010). This suggests that much work still needs to be done to encourage non-traditional STEM students to pursue degrees and careers in STEM-related fields.

This study provided the empirical evidence that community college students do engage with their peers and instructors, but the level of engagement must be improved to increase the positive influence that engagement has on students' educational goals and outcomes. The following section provides implications for use in policy and practice to increase the number of students transferring from community colleges to four-year institutions and to grow the number of community college students with STEM aspirations.

Implications for Policy and Practice

If the United States and the state of Iowa truly intend to be world leaders in education, and specifically STEM education, strategies must be put into place to increase the number of students pursuing post-secondary credentials and those credentials in STEM-related fields. The community college system will be instrumental in meeting the completion and STEM educational goals set forth by the Iowa Governor's STEM Advisory Council and President. Barack Obama. The results of this study align with many of the needs set forth by the Governor's STEM Advisory Council including the need for more interest in STEM-related fields by all students, assuring that all students are academically prepared to pursue degrees in STEM fields and increasing the number of females and under-represented minorities pursing STEM degrees and careers. This section offers strategies to meet those goals and improve the state of STEM education in the state of Iowa and the United States.

The results of the descriptive analysis revealed that all Iowa community college students, students who intend to transfer, and students with STEM aspirations have very similar demographic characteristics. They also engage with peers, college staff, faculty members, and advisors/counselors at similar rates. However, the comparative analysis revealed that several background characteristics, educational barriers, and engagement practices are more prevalent in students who intend to transfer or in students with STEM aspirations. An understanding of the factors that affect students' college outcomes can assist policymakers, administrators, faculty members, and other school personnel in using those factors to improve student outcomes, especially students' transfer intentions and STEM aspirations. Community colleges need to open the pathways for transfer to 4-year institutions and major in STEM-related fields to all students. Possible examples of how colleges can encourage all students to pursue furthering their education or majoring in STEM fields include:

- Promoting transfer opportunities and STEM careers in all promotional materials and campus visit days, especially days when parents are also invited to attend with their children. Parents are instrumental in the decision making process for many students, especially those students who may be unsure of their future goals. Promoting STEM-related educational materials to parents can provide the opportunity for further discussion about career opportunities in STEM fields and potential transfer opportunities post graduation.
- Providing diversity training to advisors/counselors, faculty, and all staff members to discuss the specific needs of students from various ethnic groups and non-native English-speaking students while attending college. Encouraging all staff and faculty members to promote STEM careers and the transfer process to all students, especially URM students and non-native English speakers. It is imperative that all staff members understand the importance of an increased and diverse STEM workforce. Offering staff members with diversity training in the area of STEM education can help make them more aware of the need for an increased number of STEM students and provide them with the necessary knowledge to speak to students who might be interested in pursuing their education in a STEM field.
- Offering training to all staff members on ways to best educate and serve non-traditional-age students. Encouraging faculty members, staff, and especially advisors/counselors to ensure that non-traditional students are made aware of the transfer opportunities and career possibilities in STEM-related fields. It is

important that community colleges provide all students with the knowledge necessary to obtain the highest degree of training and education they desire. Making non-traditional students aware of careers and transfer opportunities in STEM fields may encourage them to pursue further degrees and continue their education or pursue a degree in a STEM-related field.

- Scheduling extended office hours for academic advisors/counselors to meet with all students, especially those students who are not on campus full-time, are non-traditional, and commute to campus. Students who commute to campus, take online courses or are off campus on clinical visits may spend very little time on campus during regular office hours, but they still need the same guidance and assistance that the other students receive. Opening advising/counseling offices during non-traditional hours will allow those students to meet and discuss their educational goals and plans as needed.
- Encouraging faculty in STEM-related areas to promote STEM education and careers to female students that excel in their courses. Female students may be reluctant to pursue a career in STEM fields, but the extra push from an instructor or faculty member may encourage those students to pursue STEM careers.
- Offering additional financial aid counseling, including information on available academic scholarships, for students interested in transferring to a 4-year institution or majoring in a STEM field. Knowledge of financial aid and scholarship opportunities available at the college or university level, and especially those opportunities for STEM majors, could persuade students who are uncertain about their plans to continue their education.

- Creating STEM educational outreach events to increase STEM awareness throughout the community and especially in the K-12 academic setting. The outreach opportunities should provide educational experiences to promote STEM education to K-12 students, parents and K-12 teachers. Outreach opportunities should be centered on the Iowa Core Curriculum for math and sciences and should provide hands on opportunities for students and the community to engage in STEM experiences. Possible examples include working with groups such as the Girl Scouts, Cub Scouts, FIRST LEGO League or talented and gifted classes to design and conduct small scientific experiments that may meet the "identify questions and concepts that guide scientific investigations" or the "design and conduct a scientific investigation" essential skill requirements (Iowa Department of Education, 2012). Other outreach opportunities may include STEM awareness nights held in the elementary or middle school setting where students can conduct demonstrations, make presentations and answer questions regarding their STEM education and future career plans in STEM. These outreach events provide opportunities for students, parents and community members to better understand STEM education, STEM career possibilities and the need for a growing STEM workforce.

The logistic regression analysis for the dependent variable intention to transfer revealed that variables associated with engagement and students' background characteristics do influence students' transfer intentions. However, the logistic regression on the dependent variable STEM aspirations revealed that students' demographic and background characteristics are the only influences on students' STEM aspirations. By further understanding the factors that influence students' intentions to transfer and STEM aspirations, policymakers, administrators, faculty members, and college staff can help provide students with accessible paths to furthering their education. Examples of ways colleges can encourage students to continue their education and pursue majors in STEM fields include:

- Requiring mandatory academic advising for all first-time students. This mandatory advising session can provide the students with an academic plan for their time at the community college and the advisor can begin the discussion about the students transferring to a 4-year institution as well as the their intended major. Meeting with advisors early in the educational process will help students feel they have an education plan and that they are not alone in the educational process.
- Implementing workshop and continuing education opportunities for faculty and staff members to stress the importance of student-faculty engagement in the community college setting. The workshops most also provide real-life scenarios and practices where faculty are actively engaging with their students both inside and outside of the normal classroom environment. The CCSSE data indicates that students and faculty greatly disagree about the level of student-faculty engagement, thus calling for an increased focus on providing positive engagement opportunities throughout the college environment (McClenney & Peterson, 2006; McClenney, 2007; McClenney et al., 2007). Possible engagement practices can be gleaned from *Student Success in College: Creating Conditions that Matter* that suggests making student-faculty engagement mandatory and intentional.
- Encouraging instructors in STEM disciplines to speak to their classes about the possible careers in STEM-related fields. Not all STEM careers require students to

pursue degrees in medicine or engineering, and instructors need to make students aware of other career opportunities. Further knowledge of potential careers in STEM fields and the corresponding pay ranges may lead to an increase in the number of students enrolling in STEM-related programs and thus increasing the number of qualified workers to fill STEM-related jobs throughout Iowa and the United States.

- Offering training for dormitory residents and especially resident assistants on how to provide fellow students with encouragement and assistance and how to recognize students who might be experiencing academic, social, or mental difficulties. Community college students often work full-time and care for children or family members all while trying to complete a degree or certificate. Students deal with a number of personal and professional obstacles throughout the course of their education, but providing early intervention strategies for struggling students can help get them back on the path toward academic success and possible transfer to a 4-year institution or major in a STEM field.
- Providing and encouraging transfer fairs, transfer visits, and meetings with advisors/counselors to assist students in understanding the transfer process. Community college students may be unsure as to the discipline they would like to major, to which institution they would like to transfer, or who to go to about the transfer process. Offering specific transfer counseling, transfer fairs, and transfer visits to local 4-year institutions can provide students with the knowledge needed to make decisions about furthering their postsecondary education. Giving students the knowledge to make informed decisions about their educational future could be one

of the most positive ways colleges can influence students' transfer intentions and STEM aspirations.

- Utilizing caution when implementing online programs and courses in STEM-related fields. Prior research has indicated that students who engage with faculty in STEM disciplines are more likely to pursue STEM majors (Chen, 2009). This study found that students with STEM aspirations are more likely to frequently engage with faculty and staff than those students who do not have STEM aspirations. This indicates that students in STEM-related fields both desire and need that student-faculty interaction throughout their educational careers. Online programs, while continuing to improve, so not provide the engagement and relationship opportunities that traditional face-to-face learning continues to provide. Many community college STEM programs, especially in the health sciences, provide opportunities for hands-on experiential learning in the clinical setting that cannot be matched in an online environment. The majority of community college health sciences programs are cohort-based programs that allow students to easily foster relationships with their peers as well as their instructors. These face-to-face encounters in cohort-based programs would be difficult to emulate in an online course setting. As colleges continue the movement toward online learning, caution must be exercised when moving many STEM programs to the online-only environment.
- Establishing STEM workshops, career fairs, and mentors by which colleges with large STEM programs, STEM-related employers in the area, and community college graduates who want to continue their education in STEM fields can meet

with current students to discuss options for transfer into STEM-related disciplines and show them possible STEM areas for future employment. Meeting and discussing their educational goals and plans with alumni, colleges or potential employers allows students to ask questions and address issues that may be integral in finalizing their decision to pursue a career in a STEM field. Providing students with as much information and guidance as possible early in their educational process will only assist them in realizing their educational goals.

- Utilizing web marketing and social media to promote and encourage STEM career interest. Colleges can use a number of social media and web marketing strategies to promote their current STEM programs, showcase their STEM alumni and advertise transfer/articulation agreements with four-year institutions in STEM fields. Colleges may create a YouTube video including a testimonial from an alumnus working in a STEM field within the region, video clips of students working on class projects and then examples of STEM-related articulation agreements with four-year colleges and universities. This provides students with real-life examples of STEM success stories, glimpses into possible STEM careers and opportunities for further education after completing a degree at the community college. Colleges need to make as much use of social media and web marketing as possible in recruitment of all students, but especially those students looking to work in high-tech fields.
- Engaging in articulation agreements with 4-year institutions throughout the state to make student transfer, especially in STEM fields, easier for community college students. Community colleges must participate in discussions with 4-year

institutions to open doors for students to easily matriculate to 4-year colleges and universities.

There is no perfect solution to getting more students to transfer to 4-year institutions or to major in STEM fields, but together these implications for policy and practice can work for all students to open avenues toward transfer and STEM majors. It is recommended that community colleges look at their current practices to promote STEM education and matriculation to 4-year institutions and scrutinize what they can do within their own institutions to provide opportunities for their students to further their education.

Recommendations for Future Research

It was not intended that the findings of this study be generalizable to all students in all community colleges in the United States. This research was conducted using 15 small, urban community college districts in the state of Iowa and, therefore, the results must be carefully analyzed when making comparisons to community colleges outside of the Midwest. Future studies looking to build upon this research should consider a more diverse sample of students from which more generalizable results may be drawn.

The data collected for this research is largely self-reported data and does not provide any longitudinal results. A longitudinal study following students through the transfer process and analyzing their corresponding outcomes could provide meaningful data. Longitudinal data should include enrollment, financial aid and transcript level data. Data on a student cohort should be tracked upon initial enrollment at the community college and through transfer to the four-year institution, including data from the community college, the four-year institution and the National Student Clearinghouse. A study researching students' levels of engagement during their community college education and following those students through the transfer process would provide further data about the true influences of engagement on students' intentions to transfer and STEM aspirations.

Further research should reevaluate the current definitions of STEM education in the community college setting. Lund and Schenk (2010) note that definitions of courses and programs considered to be STEM-related are vague, especially at the community college level. Community colleges have traditionally focused on arts and sciences courses in science, technology, engineering or math as STEM-related courses, where students can easily matriculate to a four-year institution and pursue a degree in a STEM field. As four-year institutions and community colleges work together to create articulation agreements, the number of career and technical education programs with transfer opportunities continues to grow. This study found that the largest percentage of students (43.5%, n=443) who intend to transfer and major in a STEM field plan to pursue a degree in a health-related field and nearly 9% (8.9%, n=91) intend to major in computer science upon transfer. Traditionally, health occupations, computer programming and other technical programs have not been universally considered as STEM education in the community college setting. Further analysis of the definition of STEM at the community college level is needed and may offer new insights into the influence of engagement on community college students' STEM aspirations.

Future research could test the prediction models on specific subsets of community college students including: students pursuing degrees in nursing or allied health, degrees or certificates in career and technical education and arts and sciences degrees. A study of engagement practices on subsets of community college students' intentions to transfer and STEM aspirations could provide valuable data to further influence implications for policy and practice in the community college setting. Students in health-related fields as well as career and technical education programs often are members of cohorts of students who develop relationships and bonds throughout their educational process. This may increase the influence of peer engagement on their transfer intentions and STEM aspirations. These same students also often have the same instructors throughout their entire educational journey and have opportunities to develop relationships with those instructors. These relationships may increase the influence of engagement with faculty members on coursework on students' transfer intentions and STEM aspirations. A number of traditional arts and sciences students enter the community college with the intention of transferring to a four-year institution and often immediately know their intended field of study. These students develop relationships with advisors and counselors and engage early and often in the educational process. These discussions with advisors and counselors may increase the influence of transfer engagement on their transfer intentions and STEM aspirations. A comparative analysis of the engagement levels of all three subsets of students as well as testing the prediction model on the subsets would offer insight into the engagement practices of these students and offer suggestions for policy and practice to increase engagement in all areas of community college education.

Future studies may focus on conceptually and methodologically defining peer engagement in the community college setting. It is well documented that community college students often have outside commitments and influences that do not allow for time outside the normal academic day to engage with peers in an academic or social setting. The definition of peer engagement in the community college setting should focus on the varied opportunities for engagement including: participating in classroom discussions, living in dormitories, working on projects outside of the classroom, attending student sponsored activities, engaging with peers in a social environment outside of the college setting and participating in study groups. Peer engagement at the community college is extremely different from peer engagement in the four-year setting and a clear definition could better serve future research studies.

Further research could also incorporate intrinsic engagement, in the form of motivation, into the research design by promoting an interdisciplinary research design. Broadening the scope of the study to incorporate questions regarding students' motivation can provide important background data as to the students' personal pursuits of high education. Including cognitive engagement in future studies can draw conclusions on the meaningfulness of higher education, students' choices to pursue a specific field of study and students' sense of accomplishment in their goals achieved in their educational journey. The addition of intrinsic engagement in future studies may require the addition of related questions to the SSSL survey. Perhaps researchers from education, sociology and psychology can collaborate to measure multiple elements and levels of student engagement.

Further analysis of the community college student engagement model developed in this study could be utilized to study a number of other student outcomes that are at the forefront of the community college education. The student engagement model could be used to study engagement's influence on completion, retention, and graduation rates. This would add to the validity of the community college student engagement model and provide administrators and policymakers with further data on the influences of engagement on student outcomes.

Of the research that has been conducted on student engagement, very few studies have concentrated on community college students. The CCCSE focuses on five constructs associated with student engagement. This study focused on the specific questions related to engagement that influence student outcomes. The concentration on specific questions related to engagement allowed the study to provide policymakers, administrators, instructors, and students with real-life examples of engagement that influence students' learning outcomes. Further analysis of community college student engagement and specific questions related to engagement will add to this study's findings on direct influences of engagement on student outcomes and offer suggestions on how to improve student learning outcomes through the implementation of specific student engagement practices on campuses.

Conclusion

Community colleges are continuing to emerge as the college of choice for a large number of students. Many of the students who enroll in community colleges plan to complete a degree or certificate and immediately pursue a career in the workforce, many attend with the intention to transfer to a 4-year college or university, and some enroll because they are unsure of their ability or educational goals. The community colleges need to provide increased services for students and turn their focus toward the students in the third group—those that are unsure of their educational plans. These students may lack the confidence to complete a degree or certificate, the knowledge to seek advice from counselors/advisors, or an understanding of the transfer process, and therefore, need extra assistance, encouragement, and engagement with peers, faculty, and staff members.

Many students enroll in community college to complete their basic education courses before transferring to a 4-year institution but are unsure as to their intended major upon transferring to the 4-year college or university. Some of these students excelled in math or science courses in high school, have an interest in technology, or are interested in STEM-related fields but may not consider pursuing a degree in a STEM discipline. Engaging with and receiving encouragement from faculty members in STEM fields, discussing opportunities for STEM careers with academic advisors/counselors and receiving encouragement and assistance from peers and college staff can help those undecided students make the decision to pursue degrees in STEM majors.

This research study, conducted with Iowa community college students, found that students' backgrounds, along with transfer and peer engagement, influence their intentions to transfer to a 4-year institution. It also found that engagement does not influence students' STEM aspirations, but that a student's background is the largest determining factor of those aspirations. There is more research needed on the influence of engagement on community college student outcomes, especially in terms of students' intentions to transfer and STEM aspirations, and I look forward to continuing to add to the current body of literature on community college student engagement.

APPENDIX A. PILOT STUDY SURVEY

Default Question Block

Section 1: Self-Efficacy

The following questions are a series of statements about your personal attitudes and traits. For each item below, please indicate the extent to which you disagree or agree with the statement.

	Disagree strongly	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Agree strongly
When I make plans, I am certain I can make them work.	○	○	○	○	○	○	○
If I can't do a job the first time, I keep trying until I can.	○	○	○	○	○	○	○
When I have something unpleasant to do, I stick to it until I finish it.	○	○	○	○	○	○	○
When I decide to do something, I go right to work on it.	○	○	○	○	○	○	○
Failure makes me try harder.	○	○	○	○	○	○	○
I often make lists of things to do.	○	○	○	○	○	○	○
I usually mark important dates on my calendar.	○	○	○	○	○	○	○
	Disagree strongly	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Agree strongly
I know the subjects where I am academically weak and I try to improve them.	○	○	○	○	○	○	○
When I set important goals for myself, I rarely achieve them.	○	○	○	○	○	○	○
When unexpected problems occur, I don't handle them well.	○	○	○	○	○	○	○
I feel insecure about my ability to do things.	○	○	○	○	○	○	○
I do not seem capable of dealing with most problems that come up in life.	○	○	○	○	○	○	○
If something looks too complicated, I will not even bother to try it.	○	○	○	○	○	○	○
When trying to learn something new, I soon give up if I am not initially successful.	○	○	○	○	○	○	○
	Disagree strongly	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Agree strongly
I avoid trying to learn new things when they look too difficult for me.	○	○	○	○	○	○	○
I know what I want to be doing 10 years from now.	○	○	○	○	○	○	○
I wish I could have more respect for myself.	○	○	○	○	○	○	○
On the whole, I am satisfied with myself.	○	○	○	○	○	○	○
I certainly feel useless at times.	○	○	○	○	○	○	○

The following questions are a series of statements about your personal attitudes and traits in various social aspects. For each item below, please indicate the extent to which you disagree or agree with the statement.

	Disagree strongly	Disagree	Slightly disagree	Neither disagree	Slightly agree	Agree	Agree strongly

				nor agree			
It is difficult for me to make new friends.							
If I see someone I would like to meet, I go to that person instead of waiting for him or her to come to me.							
If I meet someone interesting who is hard to make friends with, I'll soon stop trying to make friends with that person.							
When I'm trying to become friends with someone who seems uninterested at first, I don't give up easily.							
I do not handle myself well in social gatherings.							

Since attending this college, how often do you engage in the following?

	Never	Rarely	Sometimes	Often	Always
Not telling my friends when I get good grades					
Acting less intelligent than I really am					
Worrying about what others think of me					
Doing things so that others will like me					
Worrying about being called a "nerd" or "braniac"					
Worrying about being accused of "acting white" or being a "sell out"					

Please think about the most challenging class you have taken in this college, and answer the following questions based on your experiences in this class.

What was the class title or number for this most challenging class?

Why was this class the most challenging?

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
Did not know how to study for the exams							
Did not know how to develop a plan of action to learn the material							
Had not taken a course in this subject before							
Course material was different than course material covered in high school							
Did not get enough feedback from the professor							
Difficult to understand the professor because of language proficiency							
Professor was not available to answer questions							
Professor did not encourage interaction with him/her							
Professor expected a low performance from me							

		Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
Factors outside of the course interfered with my ability to complete the work		○	○	○	○	○	○	○
The course required a large amount of work		○	○	○	○	○	○	○

On a scale of zero to ten (0: No Anxiety - 10: Extreme anxiety), what was your level of anxiety in this class?

	0	1	2	3	4	5	6	7	8	9	10
Anxiety (0: No Anxiety - 10: Extreme Anxiety)											

What negative impact did your anxiety have on your class performance?

- ○ No negative impact
- ○ Small negative impact
- ○ Moderate negative impact
- ○ Significant negative impact
- ○ Extremely significant negative impact

Compared with other students in the class, would you say your abilities were:

- ○ Very much above average
- ○ Above average
- ○ Average
- ○ Below average
- ○ Very much below average

When you were working at a challenging task in that class, how confident were you that you would succeed?

- ○ Extremely confident
- ○ Very confident
- ○ Confident
- ○ Somewhat confident
- ○ Not at all confident

If you succeeded at a challenging part of this class, would you say it was because of:

		Strongly disagree	Disagree	Slightly disagree	Neither disagree nor agree	Slightly agree	Agree	Strongly agree
Your high ability		○	○	○	○	○	○	○
Good luck		○	○	○	○	○	○	○
The task was easy		○	○	○	○	○	○	○
You worked hard		○	○	○	○	○	○	○

If you failed (or less successful) at a challenging part of this class, would you say it was because of

	strongly disagree	Disagree	Slightly disagree	Neither Agree nor disagree	Slightly agree	Agree	Strongly Agree
Your low ability	○	○	○	○	○	○	○
Bad luck	○	○	○	○	○	○	○
the task was hard	○	○	○	○	○	○	○
You didn't work hard enough	○	○	○	○	○	○	○

Please indicate the things you did to address the challenges in this class, and how useful they were in improving your performance.

	Did not use/not applicable	Used, not helpful	Used, somewhat helpful	Used,very helpful
Spent more time studying	○	○	○	○
Taught myself to study more effectively	○	○	○	○
Did all of the assigned reading	○	○	○	○
Did supplemental reading or assignments	○	○	○	○
Increased lecture attendance	○	○	○	○
Received a previous year's test from a friend or club/organization to study	○	○	○	○
Studied by myself	○	○	○	○
Cheated on assignments or exams	○	○	○	○
Withdrew from the course	○	○	○	○
Studied with other students in the class	○	○	○	○
Studied with people outside the class	○	○	○	○
Received informal tutoring	○	○	○	○
Received professional tutoring from Academic Success Center	○	○	○	○
Used organized review sessions	○	○	○	○
Used feedback from teacher Assistant or professor on a regular basis	○	○	○	○

For this most challenging class, did you receive encouragement or helpful advice from any of the following?

	Strongly disagree	Disagree	Slightly disagree	Neither Agree nor Disagree	Slightly disagree	Agree	Strongly Agree	Not applicable
Family member or friend	○	○	○	○	○	○	○	○
Fellow resident or Resident Assistant	○	○	○	○	○	○	○	○
Fellow classmate	○	○	○	○	○	○	○	○
Upper-class student who had taken the class	○	○	○	○	○	○	○	○
Staff person or administrator	○	○	○	○	○	○	○	○
Professional counselor	○	○	○	○	○	○	○	○
Advisor	○	○	○	○	○	○	○	○
Professor or Teacher's Assistant for this class	○	○	○	○	○	○	○	○
Academic dean	○	○	○	○	○	○	○	○
Another faculty member	○	○	○	○	○	○	○	○

In a typical week (not exam week), how many hours did you spend studying and preparing for this class?

- ○ 0, or none
- ○ Less than 1 hour
- ○ 1-2 hours
- ○ 3-5 hours
- ○ 6-10 hours
- ○ 11-20 hours
- ○ 21-35 hours
- ○ 36-45 hours
- ○ 46 hours or more

Section 2: Social Capital

What is the highest level of education completed by your parents?

	Elementary school or less	Some high school	High school graduate	Some college	Associate degree from two year college	Bachelor's degree	Some graduate school	Graduate degree	Don't know
Mother	○	○	○	○	○	○	○	○	○
Father	○	○	○	○	○	○	○	○	○

What is your best estimate of your parents' total income last year? Consider income from all sources before taxes.

- ☐ If you are independent check here
- ☐ Less than $20,000
- ☐ $20,000---$39,999
- ☐ $40,000---$59,999
- ☐ $60,000---$79,999
- ☐ $80,000 or more
- ☐ I don't know

How much of your first year's educational expenses (room, board, tuition, and fees) do you expect to cover from each of the sources listed below?

	None	Less than $1,000	$1,000 to $2,999	$3,000 to $5,999	$6,000 to $9,999	$10,000+	Don't know
Family resources (parents, relatives, spouse, etc.)	○	○	○	○	○	○	○
My own resources (savings from work, work-study, other income)	○	○	○	○	○	○	○
Employer contributions	○	○	○	○	○	○	○
Aid which need not be repaid (grants, scholarships, military funding, etc.)	○	○	○	○	○	○	○
Aid which must be repaid (loans, etc.)	○	○	○	○	○	○	○
Other than above	○	○	○	○	○	○	○

Do you have any concern about your ability to finance your college education?

None (I am confident that I will have sufficient funds)

- Some concerns (but I probably will have enough funds)
- Major concerns (not sure I will have enough funds to complete college)

Excluding yourself, how many people (children, grandchildren, brothers, sisters, parents, etc.) are you financially supporting?

- None
- 1 - 2
- 3 - 4
- 5 or above

During high school, how often did your parents or other adults:

	Never or very rarely	A few times a year	About once a month	Several times a month	Several times a week
Check if you'd done your homework	○	○	○	○	○
Help you with your homework	○	○	○	○	○
Participate in a parent-school organization (e.g., PTA)	○	○	○	○	○
Participate in other school related activities	○	○	○	○	○
Spend time talking with your friends	○	○	○	○	○

During high school, in general, how often did your parents:

	Never or very rarely	A few times a year	About once a month	Several times a month	Several times a week
Discuss political or social issues with you	○	○	○	○	○
Discuss books, films, or television programs with you	○	○	○	○	○
Listen to music with you	○	○	○	○	○
Eat the main meal with you around a table	○	○	○	○	○
Spend time just talking to you	○	○	○	○	○
Work with you on your homework	○	○	○	○	○
Discuss your progress in school with you	○	○	○	○	○

What is your mother's occupation

What is your father's occupation

What is your probable career occupation

Since arriving at this college, has your occupational expectation changed?

- Yes
- No

Please indicate why your career choice changed.

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
Lack of high school preparation for career choice requirements	○	○	○	○	○	○	○
Academic difficulty in the major course requirements for the career	○	○	○	○	○	○	○
Academic interests and values have changed since arriving at this college	○	○	○	○	○	○	○
Career interests have changed since arriving at this college	○	○	○	○	○	○	○
Career values have changed since arriving at this college	○	○	○	○	○	○	○
Lack of pre-professional learning opportunities available (e.g., internships, research opportunities)	○	○	○	○	○	○	○

If there were no obstacles, what is the highest academic degree you would like to attain in your lifetime?

- Will take classes, but do not intend to earn a degree
- Vocational certificate/Diploma
- Associate degree (A.A. or equivalent)
- Bachelors' degree (B.A., B.S., etc.)
- At least a Bachelor's, maybe more
- Master's degree (M.A., M.S., etc.)
- Doctoral degree (Ph.D., Ed.D., J.D., etc.)
- Medical degree (M.D., D.D.S., D.V.M., etc.)

Realistically, what do you expect will be your pre-tax annual income in the first full year after leaving this college?

- Less than $20,000
- $20,000—$39,999
- $40,000—$59,999
- $60,000—$79,999
- $80,000 or more

Section 3 Transfer knowledge

About how many hours a week do you usually spend on the community college campus, not counting time attending classes?

-

None

- ○ 1 to 3 hours
- ○ 4 to 6 hours
- ○ 7 to 9 hours
- ○ 10 to 12 hours
- ○ more than 12 hours

Have you taken any developmental courses in the following subjects?

- ☐ Math
- ☐ Reading
- ☐ Writing
- ☐ None

About how many hours a week do you usually spend studying or preparing for your classes?

- ○ 1 to 5 hours
- ○ 6 to 10 hours
- ○ 11 to 15 hours
- ○ 16 to 20 hours
- ○ more than 20 hours

During your time at the community college, about how many hours a week did you usually spend working on a job for pay?

- ○ None
- ○ I didn't have a job
- ○ 1 to 10 hours
- ○ 11 to 15 hours
- ○ 16 to 20 hours
- ○ 21 to 30 hours
- ○ more than 30 hours

The following items address your use of academic advising/counseling services at your community college. Please indicate the extent to which you disagree or agree with each statement.

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
I consulted with academic advisors/counselor regarding transfer.	○	○	○	○	○	○	○
Information received from academic advisors/counselors was helpful in the transfer process.	○	○	○	○	○	○	○
I met with academic advisors /counselors on a regular basis.	○	○	○	○	○	○	○
I talked with an advisor/counselor about courses to take, requirements, and education plans.	○	○	○	○	○	○	○
I discussed my plans for transferring to a four-year college or university with an academic advisor/counselor.	○	○	○	○	○	○	○
Advisors/counselors identified courses needed to meet the general education/major requirements of a	○	○	○	○	○	○	○

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
four-year college or university I was interested in attending.							

The following items pertain to your perceptions about the "transfer process" while you were enrolled at the community college. Please indicate the extent to which you disagree or agree with each statement.

	Strongly disagree	Disagree	Slightly disagree	Neither disagree nor agree	Slightly agree	Agree	Strongly Agree
I researched various aspects of 4-year institutions to get a better understanding of the environment and academic expectations.	○	○	○	○	○	○	○
I knew what to expect at 4-year institutions in terms of academics	○	○	○	○	○	○	○
I visited the 4- year institutions at least once to learn where offices and departments were located.	○	○	○	○	○	○	○
I spoke to academic counselors at 4-year institutions about transferring and major requirements.	○	○	○	○	○	○	○
I visited the admission office at 4-year institutions at least once.	○	○	○	○	○	○	○
I spoke to former community college transfer students to gain insight about their transfer experiences.	○	○	○	○	○	○	○

How often did you do each of the following at your community college?

	Never or very rarely	A few times per semester	About once a month	Several times a month	Several times a week
Visited faculty and sought their advice on class projects such as writing assignments and research papers.	○	○	○	○	○
Felt comfortable approaching faculty outside class.	○	○	○	○	○
Asked my instructor for information related to a course I was taking (grades, make-up work, assignments, etc.)	○	○	○	○	○
Visited informally and briefly with an instructor after class.	○	○	○	○	○
Discussed career plans and ambitions with a faculty member.	○	○	○	○	○
Asked my instructor for comments and criticisms about my work.	○	○	○	○	○

Have you ever felt that the faculty, staff, or administration in this college treated you poorly?

○ yes

○ No

Have you ever felt that the faculty, staff, or administration in this college treated you poorly because of your: (Check all that apply).

☐ Gender

- ☐ Race or ethnicity
- ☐ English-language proficiency
- ☐ Sexual orientation
- ☐ Religion
- ☐ Social class
- ☐ Other, please specify

To what extent do the following generally characterize the classroom environment you have experienced at this college?

	Never	Rarely	Sometimes	Often	Always
I felt I was treated respectfully in class	○	○	○	○	○
Class size made it difficult to ask questions	○	○	○	○	○
I felt isolated in class	○	○	○	○	○
Instructor expressed a lack of confidence in my ability to succeed in class	○	○	○	○	○
Instructor or students made prejudiced comments that made me uncomfortable	○	○	○	○	○
I felt like I did not fit in	○	○	○	○	○
I was ignored when I tried to participate in class discussions or ask questions	○	○	○	○	○

In your opinion, how successful has this college been at providing:

	Not at all successful	Somewhat successful	Successful	Very successful	Extremely successful
Faculty role models similar to you	○	○	○	○	○
Administrative/staff role models similar to you	○	○	○	○	○
Clubs and organizations that match your interest	○	○	○	○	○
Classroom environments that encourage your academic success	○	○	○	○	○
A sense of being a valued member of the community	○	○	○	○	○
Opportunities to interact socially with your friends	○	○	○	○	○

As things stand today do you intend to transfer to a:

- ○ 4-year public univeristy
- ○ 4-year private college or university
- ○ Private 2-year college
- ○ Public 2-year college
- ○ None

Are you planning to major in STEM upon transfer?

- ○ Yes
- ○ No

Section 4: Demographic information

Thinking about this current academic term, how would you characterize your enrollment at this college?

- ○ Full-time (12 or more credit hours)
- ○ Part-time (less than 12 credits)

Including this semester, what mathematics courses have you taken? Include courses in high school or previous college work. (Check all that apply)

- ☐ Basic math, Business math, or Pre-algebra
- ☐ Algebra I
- ☐ Geometry
- ☐ Algebra II
- ☐ Trigonometry
- ☐ Pre-calculus
- ☐ Calculus

Including this semester, what science courses have you taken? Include courses in high school or previous college work. (Check all that apply)

- ☐ General Biology
- ☐ Chemistry
- ☐ Physics
- ☐ Biology specialty (i.e., microbiology, genetics, botany, cell biology, marine biology, etc.)
- ☐ Other Earth science (i.e., geology, meterology, etc.)

What academic credentials have you earned? (Check all that apply)

- ☐ None
- ☐ High school diploma or GED
- ☐ AA (Associate of Arts)
- ☐ AS (Associate of Science)
- ☐ AGS (Associate of General Studies)
- ☐ AAA (Associate of Applied Arts)
- ☐ AAS (Associate of Applied Science)
- ☐ Diploma
- ☐ Certificate
- ☐ Other

What is your gender?

- ○ Male
- ○ Female

What is your ethnic background? (Check all that apply)

- ☐ American Indian or Alaska Native
- ☐ Asian

Black or African American

- Hispanic
- Native Hawaiian or Other Pacific Islander
- White
- Two or more races
- Race/Ethnicity Unknown

What is your age? Please specify.

What is your marital status?

- Married
- Living together (not married)
- single, never married
- divorced/separated/widowed

Do you have children who live with you?

- Yes
- No

Are your parent(s):

- Both alive and living with each other
- Both alive
- Divorced or living apart
- One or both deceased

What is your current religions preference?

- Catholic
- Protestant
- Jewish
- Islam
- Hindu
- Buddhist
- Other, please specify
- None

How many miles is this college from your permanent home?

- 5 miles or less
- 6-—10 miles
- 11-—50 miles
- 51-—100 miles
- 101-—500 miles
- Over 500 miles

Currently, what is your citizenship status?

- U.S. Citizen, native born
- U.S. Citizen, naturalized
- Non-U.S. Citizen, with a permanent resident visa/green card
- Non-U.S. Citizen, with a temporary U.S. resident visa
- Living outside the United States
- Prefer not to answer

If you were not born in the U.S., in what country were you born? Please specify.

At what age did you first come to the U.S. for an extended period of time (i.e., more than 1 month)? Please specify.

Is English your native language?

- Yes
- No

Section 5: Institution questions

Are you taking this survey in class?

- Yes
- No

Thank you very much for completing this survey.

Soko S. Starobin, Ph.D.
Assistant Professor, Educational Leadership and Policy Studies
Associate Director, office of Community College Research and Policy
starobin@iastate.edu

APPENDIX B. FINAL STEM STUDY SUCCESS LITERACY SURVEY

Default Question Block

Q1.
Dear Student,

On behalf of the research team, our sincere thank you for your time in responding to the following questions.

This survey will take approximately 15 minutes to complete. Your responses will inform research that will guide instructional practice, student services, and academic support programs to maximize student success! Your participation is critical to the project. We thank you for your attention to the questions and for completing of the survey.

Directions for filling out the survey:

- **The survey is divided into four sections. Scroll through each section to answer the questions.**
- **Please complete the entire survey (Plan on approximately 15 minutes).**
- **When reviewing questions, respond to each with what first comes to mind as the appropriate responses.**
- **Please click on NEXT at the bottom of each page to advance to the next page.**
- **If you need to leave the survey temporarily, simply close your web browser. You can come back to complete the survey through the same link within 7 days.**
- **Please click on NEXT at the end of the survey to submit your answers. You will NOT be able to make any changes once you submit.**

Upon completion of the survey, you will be automatically entered in a lottery for a random drawing. If you are selected as one of the winners in the lottery, you will be required to sign a receipt form documenting receipt of the prize. Please know that payments are subject to tax withholding requirements, which may vary depending upon whether you are a legal resident of the U.S. or another country. If required, taxes will be withheld from the prize you receive. You will need to provide your social security number (SSN) and address on a receipt form. This information allows the University to fulfill government-reporting requirements. Confidentiality measures are in place to keep this information secure. You may forgo receipt of the prize and continue in the study if you do not wish to provide your SSN and address.

All answers will become part of a larger data set, and responses are not identifiable to you as a student responder.

Again, we thank you for your time and effort.
Best Regards,
Soko S. Starobin, Ph.D.
Assistant Professor, School of Education
Director, Office of Community College Research and Policy
starobin@iastate.edu

***Q2.* Section 1: Self-Efficacy**

The following questions are a series of statements about your personal attitudes and traits. For each item below, please indicate the extent to which you disagree or agree with the statement.

	Disagree strongly	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Agree strongly
If I can't do a job the first time, I keep trying until I can.	○	○	○	○	○	○	○
When I have something unpleasant to do, I stick to it until I finish it.	○	○	○	○	○	○	○
Failure makes me try harder.	○	○	○	○	○	○	○
I often make lists of things to do.	○	○	○	○	○	○	○
I usually mark important dates on my calendar.	○	○	○	○	○	○	○
	Disagree strongly	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Agree strongly
I do not seem capable of dealing with most problems that come up in life.	○	○	○	○	○	○	○
If something looks too complicated, I will not even bother to try it.	○	○	○	○	○	○	○
When trying to learn something new, I soon give up if I am not initially successful.	○	○	○	○	○	○	○
I wish I could have more respect for myself.	○	○	○	○	○	○	○
On the whole, I am satisfied with myself.	○	○	○	○	○	○	○

***Q3.* The following questions are a series of statements about your personal attitudes and traits in various social aspects. For each item below, please indicate the extent to which you disagree or agree with the statement.**

	Disagree strongly	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Agree strongly
It is difficult for me to make new friends.	○	○	○	○	○	○	○
If I see someone I would like to meet, I go to that person instead of waiting for him or her to come to me.	○	○	○	○	○	○	○
I do not handle myself well in social gatherings.	○	○	○	○	○	○	○

Q4. Since you began attending this college, how often do you engage in the following?

	Never	Rarely	Sometimes	Often	Always
Worrying about what others think of me	○	○	○	○	○
Doing things so that others will like me	○	○	○	○	○
Worrying about being called a "nerd" or "braniac"	○	○	○	○	○
Worrying about being accused of not being myself (e.g."acting white" or being a "sell out")	○	○	○	○	○

Q5. Compared to the students at your campus, where the average student is at the 50th percent, rate your confidence about your level of skill according to the following scale.

	I'm in the bottom 10%	I'm below average but not in the bottom 10%	I'm about average	I'm above average but not in the top 10%	I'm in the top 10%	Not applicable
Math skill	○	○	○	○	○	○
Writing skill	○	○	○	○	○	○
Public speaking skill	○	○	○	○	○	○
Social skill	○	○	○	○	○	○
Computer skill	○	○	○	○	○	○

Q6. Please think about the most challenging class you have taken in this college, and answer the following questions based on your experiences in this class.

Q7. What subject does this most challenging class belong to?

○ Biology

○ Chemistry

○ English

○ Mathematics

○ Physics

○ Other, please specify

Q8. Why was this class the most challenging?

	Strongly Disagree	Disagree	Slightly Disagree	Neither agree nor disagree	Slightly Agree	Agree	Strongly Agree
Did not know how to study for the exams	○	○	○	○	○	○	○
Did not get enough feedback from the professor	○	○	○	○	○	○	○
Professor was not available to answer questions	○	○	○	○	○	○	○
Professor did not encourage interaction with him/her	○	○	○	○	○	○	○
Professor expected a low performance from me	○	○	○	○	○	○	○
The course required a large amount of work	○	○	○	○	○	○	○

Q9. On a scale of zero to ten (0: No Anxiety - 10: Extreme anxiety), what was your level of anxiety in this class?

	0	1	2	3	4	5	6	7	8	9	10
Anxiety (0: No Anxiety - 10: Extreme Anxiety)											

Q10. What negative impact did your anxiety have on your class performance?

- ○ No negative impact
- ○ Small negative impact
- ○ Moderate negative impact
- ○ Significant negative impact
- ○ Extremely significant negative impact

Q11. When you were working at a challenging task in that class, how confident were you that you would succeed?

- ○ Extremely confident
- ○ Very confident
- ○ Confident
- ○ Somewhat confident
- ○ Not at all confident

***Q12.* If you succeeded at a challenging part of this class, would you say it was because of:**

	Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree
Your high ability	○	○	○	○	○	○	○
Good luck	○	○	○	○	○	○	○
The task was easy	○	○	○	○	○	○	○
You worked hard	○	○	○	○	○	○	○

***Q13.* If you failed (or were less successful) at a challenging part of this class, would you say it was because of:**

	Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree
Your low ability	○	○	○	○	○	○	○
Bad luck	○	○	○	○	○	○	○
The task was hard	○	○	○	○	○	○	○
You didn't work hard enough	○	○	○	○	○	○	○

***Q14.* Please indicate the things you did to address the challenges in this class, and how useful they were in improving your performance.**

	Did not use/ not applicable	Used, not helpful	Used, somewhat helpful	Used, very helpful
Spent more time studying	○	○	○	○
Taught myself to study more effectively	○	○	○	○
Did all of the assigned reading	○	○	○	○
Increased lecture attendance	○	○	○	○
Received a sample test from a friend or club/organization to study	○	○	○	○
Studied by myself	○	○	○	○
Cheated on assignments or exams	○	○	○	○
Withdrew from the course	○	○	○	○
Studied with other students in the class	○	○	○	○
Received informal tutoring	○	○	○	○
Received academic support outside the class	○	○	○	○
Used feedback from Teacher Assistant or professor on a regular basis	○	○	○	○

_Q15._ For this most challenging class, how helpful was the encouragement or advice you received from the following?

	Did not receive/ not applicable	Received, not helpful	Received, somewhat helpful	Received, very helpful
Family member or friend	○	○	○	○
Fellow resident or Resident Assistant	○	○	○	○
Fellow classmate	○	○	○	○
Upper-class student who had taken the class	○	○	○	○
Staff person or administrator	○	○	○	○
Professional counselor	○	○	○	○
Advisor	○	○	○	○
Professor or Teacher's Assistant for this class	○	○	○	○
Academic dean	○	○	○	○
Another faculty member	○	○	○	○

_Q16._ In a typical week (not exam week), how many hours did you spend studying and preparing for this class?

- ○ 0 or None
- ○ Less than 1 hour
- ○ 1-2 hours
- ○ 3-5 hours
- ○ 6-10 hours
- ○ 11-20 hours
- ○ 21-35 hours
- ○ 36-45 hours
- ○ 46 hours or more

_Q17._ Section 2: Social Capital

What is the highest level of education completed by your parents?

	Elementary school or less	Some high school	High school graduate	Some college	Associate degree from two year college	Bachelor's degree	Some graduate school	Graduate degree	Don't know
Mother	○	○	○	○	○	○	○	○	○
Father	○	○	○	○	○	○	○	○	○

***Q18.* Are you financially independent (your college expenses are paid by someone other than your parents, e.g., yourself, your employer.)?**

- ○ Yes
- ○ No

***Q19.* What is your best estimate of your parents' total income last year? Consider income from all sources before taxes.**

- ○ Less than $20,000
- ○ $20,000---$39,999
- ○ $40,000---$59,999
- ○ $60,000---$79,999
- ○ $80,000 or more
- ○ I don't know

***Q20.* How much of your first year's educational expenses (room, board, tuition, and fees) do you expect to cover from each of the sources listed below?**

	None	Less than $1,000	$1,000 to $2,999	$3,000 to $5,999	$6,000 to $9,999	$10,000+	Don't know
Family resources (parents, relatives, spouse, etc.)	○	○	○	○	○	○	○
My own resources (savings from work, work-study, other income)	○	○	○	○	○	○	○
Employer contributions	○	○	○	○	○	○	○
Aid which need not be repaid (grants, scholarships, military funding, etc.)	○	○	○	○	○	○	○
Aid which must be repaid (loans, etc.)	○	○	○	○	○	○	○
Other sources than above	○	○	○	○	○	○	○

***Q21.* Do you have any concern about your ability to finance your college education?**

- ○ None (I am confident that I will have sufficient funds)
- ○ Some concerns (but I probably will have enough funds)
- ○ Major concerns (not sure I will have enough funds to complete college)

Q22. **Excluding yourself, how many people (children, grandchildren, brothers, sisters, parents, etc.) are you financially supporting?**

- None
- 1 - 2
- 3 - 4
- 5 or above

Q23. **Are you currently working?**

- Yes, I am currently working on campus.
- Yes, I am currently working off campus.
- No, I am not looking for working opportunities.
- No, I am currently unemployed, but I am looking for working opportunities.

Q24. **During your time at the community college, about how many hours a week did you usually spend working on a job for pay?**

- 1 to 10 hours
- 11 to 15 hours
- 16 to 20 hours
- 21 to 30 hours
- more than 30 hours

Q25. **During high school, how often did your parents or other adults:**

	Never or very rarely	A few times a year	About once a month	Several times a month	Several times a week
Discuss book, films, or television programs with you	○	○	○	○	○
Eat the main meal with you around a table	○	○	○	○	○
Spend time just talking to you	○	○	○	○	○
Work with you on your homework	○	○	○	○	○
Discuss your progress in school with you	○	○	○	○	○
Participate in school related activities (e.g., Parent-Teacher Association)	○	○	○	○	○
Spend time talking with your friends	○	○	○	○	○

Q26. If you were to compare yourself to your parents or guardian, would you say that you are:

- ○ Much more thrifty and likely to save what I can
- ○ Somewhat more thrifty and likely to save what I can
- ○ About as thrifty
- ○ Somewhat less thrifty and more likely to spend what I can
- ○ Much less thrifty and much more likely to spend what I can

Q27. What is your mother's occupation?

Q28. What is your father's occupation?

Q29. What is your probable career occupation?

Q30. Since arriving at this college, has your occupational expectation changed?

- ○ Yes
- ○ No

Q31. Please indicate WHY your career choice changed:

	Strongly Disagree	Disagree	Slightly Disagree	Neither agree nor disagree	Slightly Agree	Agree	Strongly Agree
Lack of high school preparation for career choice requirements	○	○	○	○	○	○	○
Academic difficulty in the major course requirements for the career	○	○	○	○	○	○	○
Academic interests and values have changed since arriving at this college	○	○	○	○	○	○	○
Career interests have changed since arriving at this college	○	○	○	○	○	○	○
Career values have changed since arriving at this college	○	○	○	○	○	○	○
Lack of pre-professional learning opportunities available (e.g., internships, research opportunities)	○	○	○	○	○	○	○

Q32. How likely would each of the following be to prevent you from obtaining your college degree?

	Not at all likely	Probably not likely	Somewhat likely	Very likely
Child care issues	○	○	○	○
Health issues	○	○	○	○
Debt-need to work more hours because of bills	○	○	○	○
Inability to balance home and school responsibilities	○	○	○	○
Inability to balance work and school responsibilities	○	○	○	○
Insufficient financial aid	○	○	○	○
Lack of money	○	○	○	○
Poor or failing grades	○	○	○	○
Transportation issues	○	○	○	○
Unprepared for college coursework	○	○	○	○
Lack of support services or resources, i.e. tutoring/mentoring/counseling	○	○	○	○

Q33. If there were no obstacles, what is the highest academic degree you would like to attain in your lifetime?

- Will take classes, but do not intend to earn a degree
- Vocational certificate/Diploma
- Associate degree (A.A. or equivalent)
- Bachelors' degree (B.A., B.S., etc.)
- At least a Bachelor' degree, maybe more
- Master's degree (M.A., M.S., etc.)
- Doctoral degree (Ph.D., Ed.D., J.D., etc.)
- Medical degree (M.D., D.D.S., D.V.M., etc.)

Q34. Realistically, what do you expect will be your annual income in the first full year after leaving this college?

- Less than $20,000
- $20,000---$39,999
- $40,000---$59,999
- $60,000---$79,999
- $80,000 or more

Q35. Section 3: Transfer knowledge

About how many hours a week do you usually spend on the community college campus, not counting time attending classes?

- None
- 1 to 3 hours
- 4 to 6 hours
- 7 to 9 hours
- 10 to 12 hours
- more than 12 hours

Q36. Have you taken any developmental courses in the following subjects? (check all that apply)

- Math
- Reading
- Writing
- None

_Q37._ About how many hours a week do you usually spend studying or preparing for your classes?

- 1 to 5 hours
- 6 to 10 hours
- 11 to 15 hours
- 16 to 20 hours
- more than 20 hours

_Q38._ The following items address your use of academic advising/counseling services at your community college. Please indicate the extent to which you disagree or agree with each statement.

	Strongly Disagree	Disagree	Slightly Disagree	Neither agree nor disagree	Slightly Agree	Agree	Strongly Agree
I consulted with academic advisors/counselor regarding transfer.	○	○	○	○	○	○	○
Information received from academic advisors/counselors was helpful in the transfer process.	○	○	○	○	○	○	○
I met with academic advisors /counselors on a regular basis.	○	○	○	○	○	○	○
I talked with an advisor/counselor about courses to take, requirements, and education plans.	○	○	○	○	○	○	○
I discussed my plans for transferring to a four-year college or university with an academic advisor/counselor.	○	○	○	○	○	○	○
Advisors/counselors identified courses needed to meet the general education/major requirements of a four-year college or university I was interested in attending.	○	○	○	○	○	○	○

_Q39._ The following items pertain to your perceptions about the "transfer process" while you were enrolled at the community college. Please indicate the extent to which you disagree or agree with each statement.

	Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly Agree
I researched various aspects of 4-year institutions to get a better understanding of the environment and academic expectations.	○	○	○	○	○	○	○
I visited the 4-year institutions at least once to learn where offices and departments were located.	○	○	○	○	○	○	○
I spoke to academic counselors at 4-year institutions about transferring and major requirements.	○	○	○	○	○	○	○
I spoke to former community college transfer students to gain insight about their transfer experiences.	○	○	○	○	○	○	○

Q40. How often did you do each of the following at your community college?

	Never or very rarely	A few times per semester	About once a month	Several times a month	Several times a week
Visited faculty and sought their advice on class projects such as writing assignments and research papers.	○	○	○	○	○
Felt comfortable approaching faculty outside class.	○	○	○	○	○
Discussed career plans and ambitions with a faculty member.	○	○	○	○	○
Asked my instructor for comments and criticisms about my work.	○	○	○	○	○

Q41. Have you ever felt that the faculty, staff, or administration in this college treated you poorly?

○ Yes

○ No

Q42. Have you ever felt that the faculty, staff, or administration in this college treated you poorly because of your: (Check all that apply).

☐ Gender

☐ Race or ethnicity

☐ English-language proficiency

☐ Sexual orientation

☐ Religion

☐ Social class

☐ Other, please specify

Q43. To what extent do the following generally characterize the classroom environment you have experienced at this college?

	Never	Rarely	Sometimes	Often	Always
I felt I was treated respectfully in class	○	○	○	○	○
Class size made it difficult to ask questions	○	○	○	○	○
I felt isolated in class	○	○	○	○	○
Instructor expressed a lack of confidence in my ability to succeed in class	○	○	○	○	○
Instructor or students made prejudiced comments that made me uncomfortable	○	○	○	○	○
I felt like I did not fit in	○	○	○	○	○
I was ignored when I tried to participate in class discussions or ask questions	○	○	○	○	○

Q44. In your opinion, how successful has this college been at providing:

	Not at all successful	Somewhat successful	Successful	Very successful	Extremely successful
Faculty role models similar to you	○	○	○	○	○
Administrative/staff role models similar to you	○	○	○	○	○
Clubs and organizations that match your interest	○	○	○	○	○
Classroom environments that encourage your academic success	○	○	○	○	○
A sense of being a valued member of the community	○	○	○	○	○
Opportunities to interact socially with your friends	○	○	○	○	○

Q45. As things stand today, do you intend to transfer to a:

- ○ 4-year public univeristy
- ○ 4-year private college or university
- ○ Private 2-year college
- ○ Public 2-year college
- ○ Not intend to transfer

Q46. Are you planning to major in STEM (Science, Technology, Engineering, and Mathematics) upon transfer?

- ○ Yes
- ○ No

Q47. Which STEM major are you planning to choose upon transfer?

Q48. Section 4: Demographic information

Is this your first semester in this college?

- ○ Yes
- ○ No

_Q49._ Thinking about this current academic term, how would you characterize your enrollment at this college?

- ○ Full-time (12 or more credit hours)
- ○ Part-time (less than 12 credits)

_Q50._ Including this semester, what mathematics courses have you taken? Include courses in high school or previous college work. (Check all that apply)

	High School	College
Basic math, Business math, or Pre-algebra	☐	☐
Algebra I	☐	☐
Geometry	☐	☐
Algebra II	☐	☐
Trigonometry	☐	☐
Pre-calculus	☐	☐
Calculus	☐	☐
Integrated/Applied Mathematics	☐	☐
Probability/Statistics	☐	☐

_Q51._ Including this semester, what science courses have you taken? Include courses in high school or previous college work. (Check all that apply)

	High School	College
General Biology	☐	☐
Chemistry	☐	☐
Physics	☐	☐
Biology specialty (i.e., microbiology, genetics, botany, cell biology, marine biology, etc.)	☐	☐
Other Earth Sciences (i.e., geology, meterology, etc.)	☐	☐
Physical Science	☐	☐

_Q52._ Have you participated in Project Lead The Way (PLTW)?

- ○ Yes
- ○ No

Q53. Have you ever attended a four-year college/university?

- ○ Yes
- ○ No

Q54. What academic credentials have you earned? (Check all that apply)

- ☐ None
- ☐ High school diploma or GED
- ☐ AA (Associate of Arts)
- ☐ AS (Associate of Science)
- ☐ AGS (Associate of General Studies)
- ☐ AAA (Associate of Applied Arts)
- ☐ AAS (Associate of Applied Science)
- ☐ Diploma
- ☐ Certificate
- ☐ Other

Q55. What is your gender?

- ○ Male
- ○ Female

Q56. How would you identify your race/ethnic background?

- ○ American Indian or Alaska Native
- ○ Asian
- ○ Black or African American
- ○ Hispanic
- ○ Native Hawaiian or other Pacific Islander
- ○ White
- ○ Two or more races
- ○ Race/Ethnicity Unknown

Q57. What is your age?

***Q58.* What is your marital status?**

- Married
- Living together (not married)
- Single, never married
- Divorced/separated/widowed

***Q59.* Are your parent(s):**

- Both alive and living with each other
- Both alive
- Divorced or living apart
- One or both deceased

***Q60.* What is your current religious preference?**

- Catholic
- Protestant
- Jewish
- Islam
- Hindu
- Buddhist
- Other, please specify
- None
- Prefer not to answer

***Q61.* How many miles is this college from your permanent home?**

- 5 miles or less
- 6---10 miles
- 11---50 miles
- 51---100 miles
- 101---500 miles
- Over 500 miles

Q62. **Currently, what is your citizenship status?**

- U.S. Citizen, native born
- U.S. Citizen, naturalized
- Non-U.S. Citizen, with a permanent resident visa/green card
- Non-U.S. Citizen, with a temporary U.S. resident visa
- Living outside the United States
- Prefer not to answer

Q63. **If you were born outside of the U.S., in what country were you born? Please specify.**

Q64. **At what age did you first come to the U.S. for an extended period of time (i.e., more than 1 month)? Please specify.**

- Birth to 3
- 4 to 7
- 8 to 12
- 13 to 17
- 18 to 21
- older than 21
- Not applicable

Q65. **Is English your native language?**

- Yes
- No

Q66. **Section 5 Institution Question**

Are you taking classes fully on-line?

- Yes
- No

Q67. **Please click the "NEXT" button to submit the survey. By submitting the survey, you will be automatically entered in a lottery for a random drawing for winning one of the five iPad 2. Good Luck!**

Thank you very much for taking the time to complete this survey.

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APPENDIX C. MASTER STUDENT DATA FILE

Indian Hills Community College

October 5, 2012

OCCRP Campus Liaison (Bianca Myers)

STEM Student Success Literacy

Creation of Master Student Data File and List of Desired Student Data

1. Creation of Master Student Data File

- Course Selection (immediately following add/drop date)
  - Courses should be selected so as to survey students who have attended at least one semester of college
  - Include:
    - Only courses offered during the Fall 2012 semester that count toward degree attainment, institutional credit or towards financial aid
    - Courses specifically related to NSF grant programs (including: STEP-UP, S-STEM, etc.)
  - Exclude:
    - If courses fall within a sequence (exe: composition I, II, III), exclude all level I or prerequisite level courses
    - Remedial/developmental courses
    - Courses that may begin after the add/drop date
    - Non-credit courses
    - Dual enrollment courses offered entirely to high school students
    - Freshman seminar or other courses offered specifically to first-term freshmen students (open to discussion)
    - Lower-level ESL courses in which students may not have adequate English proficiency to complete the survey
    - Independent study courses
    - Individual instruction courses (exe: music lessons)
    - Distance education courses (including: hybrid, online and ICN)

The STEM Student Success Literacy project is directed by Dr. Soko Starobin, Assistant Professor, School of Education and Director of Office of Community College Research and Policy at Iowa State University (ISU), based on a multi-year research study entitled, *Measuring Constructs of STEM Student Success Literacy: Community College Students' Self-Efficacy, Social Capital, and Transfer Knowledge*, funded through the College of Human Sciences at ISU

OCCRP OFFICE OF COMMUNITY COLLEGE RESEARCH & POLICY

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APPENDIX D. STEM STUDENT SUCCESS LITERACY STUDY TIMELINE

College	Survey Opened	Reminder Email	Survey Closed
Hawkeye Community College	October 1, 2012	October 8, 2012	October 15, 2012
Northeast Iowa Community College	October 9, 2012	October 15, 2012	October 24, 2012
North Iowa Area Community College	October 10, 2012	October 15, 2012	October 25, 2012
Iowa Western Community College	October 9, 2012	October 16, 2012	October 23, 2012
Marshalltown Community College	October 15, 2012	October 22, 2012	October 29, 2012
Ellsworth Community College	October 15, 2012	October 22, 2012	October 29, 2012
Des Moines Area Community College	October 15, 2012	October 22, 2012	October 29, 2012
Southwestern Community College	October 22, 2012	October 29, 2012	November 5, 2012
Iowa Central Community College	October 22, 2012	October 29, 2012	November 5, 2012
Iowa Lakes Community College	October 22, 2012	October 29, 2012	November 5, 2012
Western Iowa Tech Community College	October 29, 2012	November 5, 2012	November 12, 2012
Northwest Iowa Community College	November 13, 2012	November 19, 2012	November 30, 2012
Southeastern Community College	November 14, 2012	November 19, 2012	November 30, 2012
Eastern Iowa Community College District	November 13, 2012	November 19, 2012	November 30, 2012
Kirkwood Community College	November 13, 2012	November 19, 2012	November 30, 2012
Indian Hills Community College	November 27, 2012	December 3, 2012	December 11, 2012

APPENDIX E. CODE BOOK

Variable	Label	Description	Code
Q_14_10	Peer Engagement	Please indicate the things you did to address the challenges in this class, and how useful they were? Studied with other students in the class	1=Did not use/not applicable; 2=Used, not helpful; 3=Used, somewhat helpful; 4=Used, very helpful
Q_15_2	Peer Engagement	For this most challenging class, how helpful was the encouragement or advice you received from the following? Fellow resident or Resident Assistant	1=Did not receive/na; 2=Received, not helpful; 3=Received, somewhat helpful; 4=Received, very helpful
Q_15_3	Peer Engagement	For this most challenging class, how helpful was the encouragement or advice you received from the following? Fellow classmate	1=Did not receive/na; 2=Received, not helpful; 3=Received, somewhat helpful; 4=Received, very helpful
Q_15_4	Peer Engagement	For this most challenging class, how helpful was the encouragement or advice you received from the following? Upper class student who had taken the course	1=Did not receive/na; 2=Received, not helpful; 3=Received, somewhat helpful; 4=Received, very helpful
Q_15_5	Faculty/Staff Encouragement/ Assistance	For this most challenging class, how helpful was the encouragement or advice you received from the following? Staff member or administrator	1=Did not receive/na; 2=Received, not helpful; 3=Received, somewhat helpful; 4=Received, very helpful
Q_15_7	Faculty/Staff Encouragement/ Assistance	For this most challenging class, how helpful was the encouragement or advice you received from the following? Advisor	1=Did not receive/na; 2=Received, not helpful; 3=Received, somewhat helpful; 4=Received, very helpful
Q_15_8	Faculty/Staff Encouragement/ Assistance	For this most challenging class, how helpful was the encouragement or advice you received from the following? Professor or teacher assistant for this class	1=Did not receive/na; 2=Received, not helpful; 3=Received, somewhat helpful; 4=Received, very helpful
Q_15_9	Faculty/Staff Encouragement/ Assistance	For this most challenging class, how helpful was the encouragement or advice you received from the following? Academic Dean	1=Did not receive/na; 2=Received, not helpful; 3=Received, somewhat helpful; 4=Received, very helpful
Q_15_10	Faculty/Staff Encouragement/ Assistance	For this most challenging class, how helpful was the encouragement or advice you received from the following? Another faculty member	1=Did not receive/na; 2=Received, not helpful; 3=Received, somewhat helpful; 4=Received, very helpful
Q_17_1	Mother's Highest Level of Completed Education	What is the highest level of education completed by your parents? Mother	1=Elementary school or less; 2=Some high school; 3=High school graduate; 4=Some college; 5=Associate's degree; 6=Bachelor's degree; 7=Some graduate school; 8=Graduate degree

Q_17_2	Father's Highest Level of Completed Education	What is the highest level of education completed by your parents? Father	1=Elementary school or less; 2=Some high school; 3=High school graduate; 4=Some college; 5=Associate's degree; 6=Bachelor's degree; 7=Some graduate school; 8=Graduate degree
Q_21	Concern for Finances	Do you have any concern about your ability to finance your college education?	1=None; 2=Some concerns; 3=Major concerns
Q_23	Employment Status	Are you currently working?	1=Yes, I am currently working on campus; 2=Yes, I am currently working off campus; 3=No, I am currently not looking for working opportunities; 4=No, I am currently unemployed but am looking for working opportunities
Q_24	Hours Spent Working for Pay Weekly	During your time at the community college, about how many hours a week did you usually spend working?	1=1 to 10 hours, 2= 11 to 15 hours, 3= 16 to 20 hours; 4= 21 to 30 hours; 5= more than 30 hours
Q_33	Highest Desired Degree	If there were no obstacles, what is the highest academic degree you would like to attain in your lifetime?	1=Will take classes, but do not intend to earn a degree; 2=Vocational certificate/ Diploma; 3=Associate's degree (A.A. or equivalent); 4=Bachelor's degree; 5=At least a Bachelor's degree, maybe more; 6=Master's degree (M.A., M.S., etc.); 7= Doctoral degree (Ph.D., Ed.D., J.D., etc.); 8=Medical Degree (M.D., D.D.S., D.V.M., etc.)
Q_38_1	Transfer Engagement	The following items address your use of academic advising/counseling services at your community college-I consulted with academic advisors/counselor regarding transfer.	1=Neither Agree Nor Disagree; 2=Strongly Disagree; 3=Disagree; 4=Slightly Disagree; 5=Slightly Agree; 6=Agree; 7=Strongly Agree
Q_38_2	Transfer Engagement	The following items address your use of academic advising/counseling services at your community college-Information received from academic advisors/counselors was helpful in the transfer process.	1=Neither Agree Nor Disagree; 2=Strongly Disagree; 3=Disagree; 4=Slightly Disagree; 5=Slightly Agree; 6=Agree; 7=Strongly Agree
Q_38_3	Transfer Engagement	The following items address your use of academic advising/counseling services at your community college-I met with academic advisors/counselors on a regular basis.	1=Neither Agree Nor Disagree; 2=Strongly Disagree; 3=Disagree; 4=Slightly Disagree; 5=Slightly Agree; 6=Agree; 7=Strongly Agree

Q_38_4	Transfer Engagement	The following items address your use of academic advising/counseling services at your community college-I talked with an advisor/counselor about courses to take, requirements, and education plans.	1=Neither Agree Nor Disagree; 2=Strongly Disagree; 3=Disagree; 4=Slightly Disagree; 5=Slightly Agree; 6=Agree; 7=Strongly Agree
Q_38_5	Transfer Engagement	The following items address your use of academic advising/counseling services at your community college-I discussed my plans for transferring to a 4-year college or university with an academic advisor/counselor.	1=Neither Agree Nor Disagree; 2=Strongly Disagree; 3=Disagree; 4=Slightly Disagree; 5=Slightly Agree; 6=Agree; 7=Strongly Agree
Q_38_6	Transfer Engagement	The following items address your use of academic advising/counseling services at your community college-Advisors/counselors identified courses needed to meet the general education/major requirements of a 4-year college or university I was interested in attending.	1=Neither Agree Nor Disagree; 2=Strongly Disagree; 3=Disagree; 4=Slightly Disagree; 5=Slightly Agree; 6=Agree; 7=Strongly Agree
Q_40_1	Faculty Engagement on Coursework	How often did you do each of the following at your community college?-Visited faculty and sought their advice on class projects such as writing assignments and research papers.	1=Never or very rarely; 2=A few times per semester; 3=About once a month; 4=Several times a month; 5=Several times a week
Q_40_2	Faculty Engagement on Coursework	How often did you do each of the following at your community college?-Felt comfortable approaching faculty outside class.	1=Never or very rarely; 2=A few times per semester; 3=About once a month; 4=Several times a month; 5=Several times a week
Q_40_5	Faculty Engagement on Coursework	How often did you do each of the following at your community college?-Discussed career plans and ambitions with a faculty member.	1=Never or very rarely; 2=A few times per semester; 3=About once a month; 4=Several times a month; 5=Several times a week
Q_40_6	Faculty Engagement on Coursework	How often did you do each of the following at your community college?-Asked my instructor for comments and criticisms about my work.	1=Never or very rarely; 2=A few times per semester; 3=About once a month; 4=Several times a month; 5=Several times a week
Q_48	College Status	Is this your first semester in college?	0=Yes; 1=No
Q_49	Enrollment Status	Thinking about this current academic term, how would you characterize your enrollment at this college	0=Part-time (less than 12 credits; 1=Full-time (12 or more credit hours)
Q50_1_1	Level of Math Completed	Including this semester, what mathematics courses have you taken? High School - Basic math, business math or Pre-algebra	0=No; 1=Yes
Q50_1_2	Level of Math Completed	Including this semester, what mathematics courses have you taken? College - Basic math, business math or Pre-algebra	0=No; 1=Yes
Q50_2_1	Level of Math Completed	Including this semester, what mathematics courses have you taken? High School - Algebra I	0=No; 1=Yes

Q50_2_2	Level of Math Completed	Including this semester, what mathematics courses have you taken? College - Algebra II	0=No; 1=Yes
Q50_3_1	Level of Math Completed	Including this semester, what mathematics courses have you taken? High School - Geometry	0=No; 1=Yes
Q50_3_2	Level of Math Completed	Including this semester, what mathematics courses have you taken? College - Geometry	0=No; 1=Yes
Q50_4_1	Level of Math Completed	Including this semester, what mathematics courses have you taken? High School - Algebra II	0=No; 1=Yes
Q50_4_2	Level of Math Completed	Including this semester, what mathematics courses have you taken? College - Algebra II	0=No; 1=Yes
Q50_5_1	Level of Math Completed	Including this semester, what mathematics courses have you taken? High School - Trigonometry	0=No; 1=Yes
Q50_5_2	Level of Math Completed	Including this semester, what mathematics courses have you taken? College - Trigonometry	0=No; 1=Yes
Q50_6_1	Level of Math Completed	Including this semester, what mathematics courses have you taken? High School - Pre-calculus	0=No; 1=Yes
Q50_6_2	Level of Math Completed	Including this semester, what mathematics courses have you taken? College - Pre-calculus	0=No; 1=Yes
Q50_7_1	Level of Math Completed	Including this semester, what mathematics courses have you taken? High School - Calculus	0=No; 1=Yes
Q50_7_2	Level of Math Completed	Including this semester, what mathematics courses have you taken? College - Calculus	0=No; 1=Yes
Q50_8_1	Level of Math Completed	Including this semester, what mathematics courses have you taken? High School - Integrated/Applied Mathematics	0=No; 1=Yes
Q50_8_2	Level of Math Completed	Including this semester, what mathematics courses have you taken? College - Integrated/Applied Mathematics	0=No; 1=Yes
Q50_9_1	Level of Math Completed	Including this semester, what mathematics courses have you taken? High School - Probability/Statistics	0=No; 1=Yes
Q50_9_2	Level of Math Completed	Including this semester, what mathematics courses have you taken? College - Probability/Statistics	0=No; 1=Yes
Q51_1_1	Level of Science Completed	Including this semester, what science courses have you taken? High School - General Biology	0=No; 1=Yes
Q51_1_2	Level of Science Completed	Including this semester, what science courses have you taken? College - General Biology	0=No; 1=Yes

Q51_2_1	Level of Science Completed	Including this semester, what science courses have you taken? High School - Chemistry	0=No; 1=Yes
Q51_2_2	Level of Science Completed	Including this semester, what science courses have you taken? College - Chemistry	0=No; 1=Yes
Q51_3_1	Level of Science Completed	Including this semester, what science courses have you taken? High School - Physics	0=No; 1=Yes
Q51_3_2	Level of Science Completed	Including this semester, what science courses have you taken? College - Physics	0=No; 1=Yes
Q51_4_1	Level of Science Completed	Including this semester, what science courses have you taken? High School - Biology specialty (i.e. microbiology, genetics, botany, cell biology, marine biology, etc.)	0=No; 1=Yes
Q51_4_2	Level of Science Completed	Including this semester, what science courses have you taken? College - Biology specialty (i.e. microbiology, genetics, botany, cell biology, marine biology, etc.)	0=No; 1=Yes
Q51_5_1	Level of Science Completed	Including this semester, what science courses have you taken? High School - Other Earth Sciences (i.e. geology, meteorology, etc.)	0=No; 1=Yes
Q51_5_2	Level of Science Completed	Including this semester, what science courses have you taken? College - Other Earth Sciences (i.e. geology, meteorology, etc.)	0=No; 1=Yes
Q51_6_1	Level of Science Completed	Including this semester, what science courses have you taken? High School - Physical Science	0=No; 1=Yes
Q51_6_2	Level of Science Completed	Including this semester, what science courses have you taken? College - Physical Science	0=No; 1=Yes
Q_55	Gender	What is your gender?	0=Male; 1=Female
Q_56	Ethnicity	How would you identify your race/ethnic background?	1=American Indian or Alaska Native; 2=Asian; 3=Black or African American; 4=Native Hawaiian or other Pacific Islander; 5=White; 6=Two or more races; 7=Race/Ethnicity Unknown; 8 = "Hispanic"
Q_57	Age	What is your age?	1=18-24 years old; 2=25-39 years old; 3=≥40 years old
Q_58	Marital Status	What is your marital status?	1=Married; 2=Living together (not married); 3=Single, never married; 4=Divorced/separated/ widowed

Q61	Distance of College from Permanent Home	How many miles is this college from your permanent home?	1=0-50 miles; 2=51-100 miles; 3=101-500 miles; 4=More than 500 miles
Q65	Native Language	Is English your native language?	0=No; 1=Yes

APPENDIX F. INSTITUTIONAL REVIEW BOARD EXEMPTION

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Researc
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

DATE: March 23, 2012

TO: Soko Starobin
N243 Lagomarcino Hall

FROM: Office for Responsible Research

TITLE: **Measuring Constructs of STEM Student Success Literacy: Community College Students' Self-Efficacy, Social Capital, and Transfer Knowledge**

IRB ID: **12-124**

Submission Type: New **Exemption Date:** March 23, 2012

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects.

The determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**
- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any *modifications to the research procedures* (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the *inclusion of participants from vulnerable populations*, and/or any *change that may increase the risk or discomfort to participants. Changes to key personnel* must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

  Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

  Detailed information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. **Only the IRB or its designees may make the determination of exemption**, even if you conduct a study in the future that is exactly like this study.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

ORR 08/2011

APPENDIX G. LOGISTIC REGRESSION COEFFICIENTS: INTENTION TO TRANSFER

Variable	β	Wald	df	*p*	Odds ratio
Marital status	–0.208	2.936	1	.087	0.812
Mother's highest level of completed education	0.104	9.691	1	.002**	1.109
Father's highest level of completed education	–0.008	.073	1	.787	0.992
Level of science completed	–0.042	.162	1	.687	0.959
Level of math completed	–0.048	.153	1	.695	0.953
Enrollment status	0.051	.222	1	.638	1.052
College status	–0.086	.354	1	.552	0.918
Distance of college from permanent home	0.087	.814	1	.367	1.091
Native Language	–0.399	2.088	1	.148	0.671
Age	–0.224	8.331	1	.004**	0.799
Gender	–0.064	.312	1	.577	0.938
Under–represented minorities	–0.070	.172	1	.678	0.933
STEM aspirations	1.472	107.077	1	.000****	4.357
Highest desired degree	0.532	184.543	1	.000****	1.703
Concern for finances	0.070	.943	1	.332	1.072
Hours spent working for pay weekly	0.004	.013	1	.910	1.004
Studied with other students in the class	–0.048	.924	1	.336	0.953
Encouragement or advice from fellow classmates	–0.028	.294	1	.588	0.972
Visited faculty and sought their advice on class projects such as writing assignments and research papers	0.016	.095	1	.758	1.016
Felt comfortable approaching faculty outside class	–0.035	.544	1	.461	0.965
Discussed career plans and ambitions with a faculty member	–0.023	.181	1	.670	0.977
Asked my instructor for comments and criticisms about my work	–0.040	.691	1	.406	0.961
I consulted with academic advisors/counselors regarding transfer	0.155	17.923	1	.000***	1.168
Information received from academic advisors/counselors was helpful in the transfer process	–0.059	2.747	1	.097	0.943
I discussed my plans for transferring to a four–year college or university with an academic advisor/counselor	0.379	110.056	1	.000***	1.461
Advisors/counselors identified courses needed to meet the general education/major requirements of a four–year college or university I was interested in attending	0.102	11.440	1	.001***	1.107
Encouragement or advice from fellow resident or resident assistant	0.150	5.207	1	.022†	1.162
Encouragement or advice from staff person or administrator	–0.029	.334	1	.564	0.972
Encouragement or advice from advisor	0.006	.008	1	.928	1.006
Encouragement or advice from another faculty member	–0.036	.260	1	.610	0.966
Constant	–3.440	45.825	1	.000***	0.032

†$p \leq .05$. **$p \leq .005$. ***$p \leq .001$.

APPENDIX H. LOGISTIC REGRESSION COEFFICIENTS: STEM ASPIRATIONS

Variable	β	Wald	*df*	*p*	Odds ratio
Marital status	0.047	0.130	1	.719	1.048
Mother's highest level of completed education	0.009	0.069	1	.792	1.009
Father's highest level of completed education	–0.017	0.322	1	.571	0.983
Level of science completed	0.561	31.197	1	.000***	1.753
Level of math completed	0.447	16.391	1	.000***	1.564
Enrollment status	0.013	0.013	1	.911	1.013
College status	0.022	0.022	1	.881	1.023
Distance of college from permanent home	0.007	0.006	1	.94	1.007
Native Language	–0.693	9.373	1	.002**	0.500
Age	0.249	8.845	1	.003**	1.283
Gender	–0.527	23.864	1	.000***	0.590
Under-represented minorities	–0.207	1.537	1	.215	0.813
Concern for finances	0.154	4.217	1	.040†	1.116
Hours spent working for pay weekly	–0.105	7.681	1	.006*	0.901
Highest desired degree	0.200	22.910	1	.000***	1.221
Intention to Transfer	1.461	111.519	1	.000***	4.310
Studied with other students in the class	0.030	0.352	1	.553	1.030
Encouragement or advice from fellow classmates	0.032	0.359	1	.549	1.032
Visited faculty and sought their advice on class projects such as writing assignments and research papers	–0.010	0.033	1	.855	0.990
Felt comfortable approaching faculty outside class	–0.002	0.022	1	.967	0.998
Discussed career plans and ambitions with a faculty member	–0.078	1.996	1	.158	0.925
Asked my instructor for comments and criticisms about my work	0.084	2.905	1	.088	1.087
I consulted with academic advisors/counselors regarding transfer	–0.017	0.206	1	.650	0.983
Information received from academic advisors/counselors was helpful in the transfer process	0.027	0.592	1	.441	1.027
I discussed my plans for transferring to a 4-year college or university with an academic advisor/counselor	0.038	0.231	1	.631	1.018
Advisors/counselors identified courses needed to meet the general education/major requirements of a 4-year college or university I was interested in attending	–0.028	0.706	1	.401	0.973
Encouragement or advice from fellow resident or resident assistant	0.047	0.579	1	.447	1.048
Encouragement or advice from staff person or administrator	0.037	0.548	1	.459	1.038
Encouragement or advice from advisor	–0.038	0.352	1	.553	0.963
Encouragement or advice from another faculty member	0.076	1.353	1	.245	1.079
Constant	–4.417	78.245	1	.000***	0.012

†$p \leq .05$. *$p \leq .01$. **$p \leq .005$. ***$p \leq .001$.

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