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An investigation of the relationships of student engagement and academic performance of supplemental instruction students concurrently enrolled in a gateway mathematics course at California State University in Southern California

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AN INVESTIGATION OF THE RELATIONSHIPS OF STUDENT ENGAGEMENT AND ACADEMIC PERFORMANCE OF SUPPLEMENTAL INSTRUCTION STUDENTS CONCURRENTLY ENROLLED IN A GATEWAY MATHEMATICS COURSE AT CALIFORNIA STATE UNIVERSITY IN SOUTHERN CALIFORNIA

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by

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VITA

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ABSTRACT

This study, conducted at California State University (CSU) in Southern California, focused on student engagement factors and academic performance of supplemental instruction (SI) students concurrently enrolled in a gateway mathematics course. The purpose of this quantitative correlational survey study was to investigate engagement factors employed by SI students enrolled in gateway mathematics courses; the researcher explored the relationships of the SI students' engagement factors to their gateway mathematics course grades. The participants completed a web-based survey in which they responded to items regarding their behaviors, thoughts, and feelings as experienced in the gateway mathematics course and the SI class sessions. The responses were scored within 4 engagement factor scales including skills engagement, emotional engagement, participation/interaction engagement, and performance engagement. The results of this study provided support for 2 alternative hypotheses: (a) there was a positive relationship between each of the 4 engagement factors and the gateway mathematics course grades of the participants, and (b) there was a positive relationship of the linear combination of the 4 engagement factors to the gateway mathematics course grades of the participants. The findings of this research study supported 3 conclusions: (a) engagement is a multidimensional construct, and the more students are engaged in their studies, the more likely they are to earn higher grades in a gateway mathematics course; (b) academic support and resources are essential for student learning; (c) college success, specifically, positive academic course performance, is a significant indicator of persistence toward college completion. Recommendations based on the findings and conclusions of this study include regular collaboration of efforts among all university stakeholders to provide a variety of student-centered

venues for academic support and resources to engage students in developing self-efficacy for academic success in gateway mathematics courses.

Chapter 1: Introduction

This study focused on the investigation of engagement factors employed by students enrolled in a supplemental instruction (SI) course and the relationships of these factors to the students' grades earned in their attached gateway mathematics course. Chapter 1 is presented in 11 sections: (a) background information, (b) problem statement, (c) purpose of the study, (d) importance of the study, (e) definitions of key terms, (f) theoretical/conceptual framework summary; (g) research questions and hypotheses, (h) limitations, (i) delimitations, (j) assumptions, and (k) organization of the study.

Background of the Study

According to a 2013 NCES Statistical Analysis Report of a nationwide sample of first-time entry postsecondary students, attrition rates for science, technology, engineering and mathematics (STEM) majors and non-STEM majors at the bachelor's degree levels were extremely high between the years of 2003-2009. For instance, 48% of STEM students had left the STEM field by changing majors or leaving college without completing a degree or certificate. Similarly, attrition in the non-STEM majors such as humanities, social sciences, and health sciences were 56-62% and non-STEM majors, including business and social/behavioral science, showed attrition rates of 50% and 45%, respectively (Chen & Soldner, 2013). These attrition rates have been affected by low student persistence for several reasons, including stop outs, dropouts, and frequent failure in difficult courses during the first and second year of college enrollment. These difficult courses have typically included required gateway courses in the STEM fields and non-STEM fields. Gateway mathematics courses are also called introductory college level math courses, including algebra and number theory, geometry, computational mathematics, financial mathematics, and calculus (Radford & Horn, 2012). For instance, regardless of the major field of study, most students were required to enroll in at least one gateway mathematics course for advancement through their STEM or Non-STEM program; gateway mathematics courses have been traditionally considered high-risk courses that affect student attrition (Chen & Soldner, 2013). Martin and Arendale (1992) defined a high-risk course at many college campuses as an entry-level course where more than 30% of the enrolled students earn a final course grade of D, F, or W (withdrawal). Research has shown that high attrition rates occur within the first 2 years of enrollment into gateway courses in the sciences (Chang, Cerna, Han, & Saenz, 2008). The rate of student attrition across courses is greatest in the first 6 weeks or after poor grades are earned on the first course assessment (Blanc, DeBuhr, & Martin, 1983; Noel, Levitz, & Saluri, 1985).

For decades, colleges and universities have created programs and services to support student success in high-risk gateway courses and to increase student retention (Arendale, 2000; Martin & Arendale, 1992; Tinto, 1993). Thus, since 1973, the SI model has been offered at more than 1,000 universities across the United States and in other countries for students to voluntarily attend during the first or second week of the course term to gain assistance with studies of the high-risk course material. SI courses were initially designed to help talented medical, pharmacy, and dentistry graduate students at the University of Missouri-Kansas City (UMKC), since excessively large numbers of these students had dropped out or were academically dismissed from these programs within the first year due to academic difficulties. It is estimated that more than a quarter-million students attend SI sessions each academic term. Many different institutions have reported significant increases in student retention and course grades in a variety of subjects (Kallison & Kenney, 1992; Kenney, 1988; Lundeberg, 1990).

The supplemental instruction program at CSU is offered through the learning assistance center (LAC). Its mission is to improve student retention and success in difficult gateway courses by providing collaborative peer-learning experiences to enhance content knowledge, foster critical thinking, and develop study skills. This service is offered by the CSU in the form of a one-unit, credit/no-credit course, and enrollment is voluntary. Each SI section is assigned to a specific course (*target* course), particularly an entry-level gateway course. The purpose of the SI program at CSU is twofold: to help students master course content, and to encourage students to reflect on their evolution as lifelong learners. The ultimate goal is to help the students achieve their fullest potential at CSU and in their future endeavors[1].

Past research studies have concentrated on the effectiveness of SI programs; most results have compared the high-risk course outcomes of the SI students to non-SI students with regard to course grades, course pass rates, and retention rates (Arendale, 2000; Blanc et al., 1983; Martin & Arendale, 1992) For instance, SI students who have attended class regularly (at least 10 sessions during the academic term) have statistically earned higher grades of half a letter to a full letter grade higher than those students who did not attend (Blanc et al., 1983; Martin & Arendale, 1992; Rath, Peterfreund, Bayliss, Rundquist, & Simonis, 2012).

However, none of these studies have addressed what factors contribute to this difference in grades. Also, the discussion sections of several studies have offered limited findings on the reasons for the student outcomes. For instance, Rath et al. (2012) recommended further examination of the impact of the activities undertaken within SI sections of chemistry courses on student performance. They suggested that one issue that could be explored is the variance in presentation styles of SI facilitators during the SI workshops. Also, based on typical responses

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[1] This information was taken from a source that would reveal the identity of the participating institution. Therefore, the source has been omitted intentionally.

from the end of term student surveys, there was an indication that some facilitators operated their SI sessions differently, and the facilitators often possessed various levels of knowledge. In fact, in one study, data of student grades varied considerably with each facilitator. Even though the ratio of student to facilitators was small, there were only a few courses with statistical significance of positive academic performance. Finally, given that SI facilitator and leader training is consistent with the use of the techniques outlined in the UMKC SI model, there were no reports of a significant difference in student outcomes even with different facilitator styles for SI sessions.

Moreover, Martin and Arendale (1992) mentioned that a combination of factors could contribute to the positive effects of participation in the SI courses, but no specific focus was discussed regarding student participation in specific activities besides those cognitive and study strategies implemented in the regular SI model. Similarly, Blanc et al. (1983) suggested that further investigation should be conducted on other factors that may have contributed to the effects of the SI services on student performance and learning.

Therefore, of particular interest in research over the past 30 years at colleges and universities has been a focus on student engagement practices through the college experience to explore relationships of positive associations with student learning, performance outcomes, retention, and college success (Kuh, 2009; National Survey of Student Engagement [NSSE], 2000; Pace, 1984). At the four-year college level, many studies have assessed student engagement, including projects such as the College Student Experience Questionnaire (CSEQ; Pace, 1984) and the National Survey of Student Engagement (NSSE, 2000) at Indiana University. For example, the CSEQ measures the impact of the quality of effort in the college experience of students to improved learning and development, and the NSSE measures institutional excellence and the quality of the undergraduate student experience that links engagement to student learning and performance outcomes (Kuh, 2009). Also, "the NSSE focuses on active learning and other educational experiences but does not focus on individual courses; rather it assesses students' overall perceptions" (Handelsman, Briggs, Sullivan, & Towler, 2005, p. 184) of their college experience. However, college faculty and individual academic departments that have interest in program quality improvement have tended to focus on the level of student engagement in specific lower division college courses and high-risk courses (Burch, Heller, Burch, Freed, & Steed, 2015; Handelsman et al., 2005). Most faculty at the course level believe that the strongest influence on student behavior and relationships to academic performance comes from the classroom, and that students' level of engagement may vary across courses over a specific time (Handelsman et al., 2005).

Svanum and Bigatti (2006) expressed that "Contemporary models of student learning emphasize student engagement and effort as important variables in course success" (p. 564). Similarly, learner engagement in the classroom leads to effective outcomes (Sims, Burke, Metcalf, & Salas, 2008). Burch et al. (2015) considered student engagement in academic courses among the better predictors of student learning and development; subsequently, SI courses provide opportunities for students to engage in their learning of high-risk course content. Thus, the aim of this study was to investigate which engagement factors were employed by SI students that significantly affected their gateway mathematic course grades.

Statement of the Problem

Many gateway courses in the STEM fields and non-STEM fields have been considered high-risk courses in which students have experienced academic difficulties. Thus, many universities, including CSU, have offered SI programs to support students enrolled in high-risk course, including gateway mathematics courses. Pace (1984) asserted that "accountability for achievement and related student outcomes must consider both what the institution offers and what the students do with those offerings" (p. 6). So, although the institution offers SI courses to help students excel through the high-risk courses, it is up to the student to take the initiative to attend the SI courses. Also, students know that they are accountable for the amount, scope, and quality of effort they invest in their learning experiences and development. Likewise, students know that the engagement and effort they put into their college experience leads to equivalent earned performance outcomes (Pace, 1982). Hence, since attending the SI course is voluntary and the course is graded as credit or non-credit, then the student is accountable for how much he or she engages in the activities that are offered during the SI sessions.

However, despite past research results that have shown SI programs yielding significant improvements in student performance and retention rates, it has been difficult to assess which factors of the SI program contributed to the observed effects. Blanc et al. (1983) also noted that a potential combination of factors influences higher levels of student academic performance but did not specify details of services. Furthermore, no past SI program research studies have pointed to student engagement factors within or outside the SI program session that could have contributed to the effects of increased academic performance and retention in the high-risk courses. Also, there is little evidence showing the extent to which SI students have used engagement factors or strategies that have affected their grades in their attached gateway mathematics course.

Therefore, there is a need to expand research on student engagement factors employed by students enrolled in SI courses that improved their learning and academic performance in their high-risk courses. Since gateway mathematics courses are considered high-risk courses that affect student persistence toward college completion, this study investigated engagement factors of SI students enrolled in these gateway mathematics courses and the relationships between those factors and their math course grades.

Purpose of the Study

The purpose of this quantitative correlational survey study, conducted at CSU, was to investigate engagement factors employed by SI students enrolled in gateway mathematics courses. In addition, the researcher explored the relationships of the SI students' engagement factors to their gateway mathematics course grades.

Importance of the Study

This quantitative survey study is significant for several reasons. The course-specific snapshot of academic engagement and effort complements the global picture of the college experience as measured by the NSSE (Handelsman et al., 2005). Burch et al. (2015) claimed that measuring student engagement at the course level is essential to the development of strong curricula and the improvement of instructional practices. The four factors of engagement explored in this study may prompt further research on the relationships among the classroom experience, engagement, and learning outcomes. Likewise, Handelsman et al. (2005) asserted that the results from the study of academic course engagement provides educators with tools to systematically modify the learning environment with activities that complement individual differences and lead to highly engaged students. Also, Briggs, Sullivan, and Handelsman (2004) asserted that if student engagement is detected and addressed early in a course, it can positively transform student attitudes and lead to valuable learning experiences. Similarly, the results of this study may be particularly valuable for instructors who teach part-time, older, and commuter students who are typically not globally engaged in their college experience and need inspiration during class sessions (Handelsman et al., 2005).

Furthermore, gaining the students' perspective regarding their engagement levels and practices in the gateway mathematics courses while attending the SI courses will help to incorporate a collaborative effort of program design for the key facilitators of the SI model and the faculty of the mathematics department, who may then integrate more student-centered opportunities that promote academic success. In addition, the results of this study will help bridge the gap between the theoretical approaches promoting student engagement from the instructors, the curriculum developers, administration and policymakers and the student perspectives on what factors promote student success in gateway mathematics courses. This study will expand the existing knowledge base and body of literature, providing recommendations about methodology and pedagogy to develop engagement strategies that SI facilitators can integrate within the SI program model. Finally, this study is timely since it may broaden insights for any stakeholders in the educational programs as they explore the best practices in engaging students in their college experiences for academic success, sustained persistence through each course, and ultimate completion of their college program.

Definition of Terms

The following terms are used throughout this study:

- *College Completion:* Completion of an established college or university degree program with a series of college credit courses that result in the completion of all requirements.
- *College Success:* College success can be defined with a focus on either performance outcomes, such as course or semester grades, college persistence over one or two semesters, or degree attainment (Svanum & Bigatti, 2009).

- *Dropout:* The departure of a student from an educational institution without completion of the proposed degree or certificate program (Tinto, 1993).
- *Stopout:* A stopout occurs when a student temporary withdraws for a specified academic term or a short leave of absence but sometimes chooses not to return after the designated period (Tinto, 1993).
- *Gateway Mathematics Course:* Introductory college-level math course that is an essential prerequisite to advanced math courses, advanced STEM courses, and any other program of study (Chen & Soldner, 2013).
- *High-Risk Course:* At many college campuses, this course is considered an entry-level course where more than 30% of the enrolled students earn a final course grade of D, F, or W (Martin & Arendale, 1992).
- *Supplemental Instruction (SI):* Developed by Dr. Deanna Martin in 1973 at UMKC, SI is a voluntary academic support program that aims to increase student performance and retention in at-risk courses. (Martin & Arendale, 1992).
- *STEM:* Refers to science, technology, engineering, and mathematics fields, which include biological sciences, physical sciences, and computer and information sciences (Chen & Soldner, 2013).

Theoretical/Conceptual Framework

The conceptual model that framed this study is based on constructs developed in previous research studies by Handelsman et al. (2005) that relate four dimensions of college student course engagement: skills engagement, participation/interaction engagement, emotional engagement, and performance engagement. These factors were deemed distinct and reliable in Handelsman et al.'s studies on academic course engagement and were linked to theoretical work by Dweck and Leggett (1988) in the psychological literature relating to self-theories, student goal orientation, and academic performance, namely grades (Handelsman et al., 2005). Chapter 2 will further explore literature on these concepts in more depth.

Research Questions

Research questions. To gain a better understanding of the effects of student engagement factors on course grades of students enrolled in a gateway mathematics course, the researcher explored the following research questions with SI students at CSU in Southern California.

1. To what extent, if at all, are any of the SI students' academic course engagement factors individually related to their gateway mathematics course grades?
2. To what extent, if at all, is the linear combination of the SI students' four academic course engagement factors related to their gateway mathematics course grades?

Hypotheses (alternative).

Ha1: At least one of the four academic course engagement factors is related to the students' gateway mathematics course grades.

Ha2: The linear combination of the four course engagement factors is related to the students' gateway mathematics course grades.

Hypotheses (null).

Ha1: None of the four academic course engagement factors are related to the students' gateway mathematics course grades.

Ha2: The linear combination of the four course engagement factors is not related to the students' gateway mathematics course grades.

Limitations

The researcher has determined several factors that may have influenced the interpretation of findings or generalizability of results of this study. For example, since the survey was distributed via the internet, then participants may have experienced challenges such as internet connectivity, knowledge of navigation of the survey tool, or other issues that may have affected the accurate completion of the survey. Also, since participation was voluntary, then the sample of participants may not be representative of the diversity of the population of gateway mathematics students enrolled concurrently in the SI course.

Delimitations

The researcher conducted this study at one CSU in Southern California; therefore, the results of this type of study may vary at other institutions. Also, the researcher selected a small sample of students enrolled in SI courses while enrolled in the attached target gateway mathematics course; Creswell (2009) stated that this type of sampling may limit generalizability to larger populations. Furthermore, the validity of gathered data was limited to information collected from self-reported responses to survey questions that were administered through a web-based survey. Finally, since the study focused on students enrolled in one course subject, then the results may not represent other course subjects.

Assumptions

The researcher made several assumptions in conducting this study. First, the researcher assumed that the participants were knowledgeable about the supplemental course in which they were enrolled. Secondly, the researcher assumed that the participants responded to the survey questions with honesty, sincerity, and critical self-reflection. Similarly, the researcher assumed that participants honestly reported their grades earned in the gateway mathematics course.

Thirdly, the researcher assumed that the duration of a one-semester course was sufficient time for participants to experience learning strategies and progress toward academic achievement of their grades.

Organization of Study

This study is organized into five chapters. Chapter 1 presents background information, the problem statement, the purpose of the study, theoretical/conceptual framework, and the research questions. Chapter 2 offers a comprehensive review of the literature, including: (a) history of SI, (b) theoretical lens to support student engagement, and (c) a review of literature related to the key variables of the study. Chapter 3 presents the research methodology of the study. This description includes details of the (a) setting, (b) population, (c) sampling, (d) human subject considerations (e) instrumentation (f) data collection, (g) data management, (h) data analysis procedures, and (i) positionality of the researcher. Chapter 4 presents the findings and a summary of the key findings. Chapter 5 provides a discussion of the findings, conclusions, implications for policy and practice, recommendations for further study, and summary of the entire study.

Chapter 2: Literature Review

This chapter presents a review of the literature relevant to this study of student engagement in SI courses and academic performance in gateway mathematics courses. This literature review presents sections on the history of SI, relevant research on SI course participation and effects on academic performance and retention in high-risk courses, the history of engagement and significant research on academic course engagement, postsecondary data and relevant research on STEM courses including gateway mathematics that relates to student attrition, student retention, predictors of success, and student engagement. This literature review is organized into 10 sections: (a) history of SI, (b) past research of SI, (c) history of student engagement, (d) academic course engagement (e), theoretical framework, (f) conceptual framework, (g) four factors of engagement, (h) engagement opportunities in SI, (i) gateway mathematics, and (j) summary.

History of Supplemental Instruction

As early as 1973, Dr. Deanna Martin created a program called SI as a response to high attrition rates within the professional science schools at UMKC (Arendale, 2000; Martin & Arendale, 1992). At that time, more than 30% of the students in the schools of dentistry, medicine, and pharmacy had academic difficulty with particular high-risk courses even though the students were not considered at-risk (Martin & Arendale, 1992). After the SI programs showed significant positive outcomes for the graduate professional students, the SI program was extended to services for undergraduate students. Since then, the SI program model has been expanded to more than 1,000 post-secondary institutions in the United States and other countries.

SI identifies at-risk courses instead of at-risk students. Traditional courses with high failure rates occur in STEM fields, such as algebra, calculus, chemistry, and anatomy; some courses are in non-STEM fields such as political science and economics. At CSU, the criteria used to identify high-risk courses include high percentages of D and F grades, large lecture courses that minimize faculty-student interaction, courses found difficult based on technical nature such as the sciences and mathematics, and unfamiliarity of the target population with disciplines such as economics and advanced math courses (Maxwell, 1997).

Enrollment in SI is typically voluntary, and students with various levels of academic abilities attend the SI sessions. Also, since SI is introduced during the second week of classes and is open to all students in the high-risk course, the program is not viewed as remedial. During the SI sessions, participants review key concepts from lecture content, emphasize study skills, and focus on collaborative learning activities among students (Blanc et al., 1983; Maxwell, 1997; Martin & Arendale, 1992). SI sessions are offered in formal settings that are facilitated by the lecture instructor or SI leader, and SI sessions are offered in informal settings such as SI leader facilitated study sessions where students attend sessions as needed. Sometimes SI leaders meet with students in one-on-one sessions to provide additional help.

The SI leader is typically a fellow student who has demonstrated competence in the subject matter and has earned a B or higher in the course. In addition to course competence, a good SI leader often has characteristics that include having an interest in people, an interest in discussing others' ideas, as well as the ability and willingness to: give time to the students, share concerns with other leaders and staff, display open and inspiring trust, give encouragement, t inspire confidence, and help students build better decision-making skills (Wallace, 2003). SI leaders attend several hours of training, which consists of workshops that emphasize learning models, teaching methods, study strategies, and techniques to manage student interactions (Martin & Arendale, 1994). Also, SI leaders regularly attend workshops and meetings throughout the term to discuss students' progress, share ideas with other SI leaders, and learn instructional strategies for implementation in their SI sessions. Furthermore, SI leaders must attend the lecture course, take significant notes, and meet regularly with the lecture instructor. SI leaders are observed by SI supervisors once a semester (at minimum) and are required to report session content and attendance weekly (Arendale, 2000; Martin & Arendale, 1992).

In general, most universities follow the standard SI model where all SI courses are facilitated by SI leaders who attend the lecture courses with the students and then lead two or three weekly review sessions throughout the academic term. During each session, the SI leaders facilitate a variety of hands-on learning activities to foster a deeper understanding of the course material (Arendale, 1992).

Past Research on Supplemental Instruction

Approximately 450 professional articles, research studies, conference proceedings, and other forms of media have been written about SI by staff from the SI Center at UMKC and other SI administrators and scholars from around the world (Arendale, 2000). Research studies have replicated findings that the effects of the SI program have produced improved academic achievement, persistence, and graduation rates (Martin & Arendale, 1992). Researchers have reported that most students, including the talented upper quartile students, have earned higher grades with SI participation (Arendale, 2000; Martin & Arendale, 1992).

Initial research studies were conducted as early as 1981 at UMKC and other institutions to study the effectiveness of the SI model in yielding positive changes in academic performance. Most research studies employed comparative studies of the academic performance of SI participants to the non-SI participants enrolled in high-risk courses. Additional analysis included motivation to participate, pre-enrollment academic achievement, and ethnicity. The most common dependent variables assigned in the studies were course grades, re-enrollment, and graduation rates. The typical population of the studies included all students enrolled in a specified high-risk course. Common instruments and procedures utilized in most studies included course rosters and background data on admissions exam scores, high school rank, and high school grade point average (GPA). Student surveys of the program were regularly administered at the beginning and end of the course term. Often the first-course examination grades were reviewed as well as final grades of the course term, re-enrollment information, and graduation data of the students who were enrolled in the target high-risk courses.

Since 1980, UMKC has offered SI services in 190 courses to students at the undergraduate, graduate, and professional school level. Research data has revealed that most SI participants at UMKC earned A and B final course grades; likewise, SI participants earned lower percentages of D, F, and W final course grades than the non-SI participants (Martin & Arendale, 1992). Also, researchers have reported that regardless of ethnicity, SI participants within targeted high-risk courses succeeded at a higher rate than non-participants of SI. Similarly, in another study of 2,410 students at 13 colleges and universities, UMKC reported that minority students who attended SI earned higher final course grades than their non-participating peers (Martin & Arendale, 1992).

In 1981, the SI program became one of the few post-secondary programs designated by the U.S. Department of Education as an Exemplary Educational Program. The SI program was recertified in 1985 and 1992 by the U.S. Department of Education, which validated the following three claims of effectiveness of the SI Program:

> 1. Students participating in SI within the targeted high-risk courses earn higher mean final course grades than students who do not participate in SI. 2. Despite ethnicity and prior academic achievement, students participating in SI within targeted high-risk courses succeed at a higher rate (withdraw at a lower rate and receive a lower percentage of D or

> F final course grades) than those who do not participate in SI. 3. Students participating in SI persist at the institution (re-enroll and graduate) at higher rates than students who do not participate in SI. (Martin & Arendale, 1992, p. 26)

Throughout the past 30 years, the International Center for SI and its certified trainers around the globe have supported the establishment of healthy SI retention programs in many post-secondary institutions including community colleges, liberal arts colleges, research institutions, urban-metropolitan universities, rural universities, professional schools, graduate schools, medical schools, and international schools. From 1997 to the present day, SI programs have extended the SI model to help students who would not regularly attend the traditional SI sessions and students who need additional interventions for academic support. For instance, video-based supplemental instruction (VSI) has been implemented in many secondary schools and post-secondary schools in the United States and abroad. VSI was designed to integrate academic support into the targeted course. In VSI courses, instructors videotape their lectures and students enroll in a video section of the class rather than in the traditional lecture section. The lectures are regulated by the VSI facilitator who determines the level of students' understanding of the course content. Program evaluators have found that the VSI management of time-specific tasks has helped students develop more proficient skills in writing, note taking, reading, and critical thinking. Also, based on numerous program evaluations conducted at UMKC between 1997 and 2005, the data have shown that a lower percentage of VSI students who earned a D or F or withdrew from the class than that of the non-VSI students who were enrolled in chemistry, history, and intermediate algebra courses (Hurley, Patterson, & Wilcox, 2006).

Breaking the attrition cycle. Blanc et al. (1983) conducted a program evaluation study of SI at a large urban post-secondary institution with an enrollment of 11,000 students. The population included college freshmen and sophomores enrolled in seven entry-level arts and sciences courses including biology, chemistry, economics, and history. The study focused on course performance with final grades, average semester GPA, retention rates, and percentage of Ds, Fs, and Ws (DFWs) during semesters from Spring 1980 to Spring 1981. The sample size of 746 students consisted of 261 SI students, 132 non-SI students were interested in attending SI but could not attend for scheduling conflicts with work or other courses, and 353 non-SI others

During the Spring 1980 term, academic performance appeared to be equivalent across the three groups of students. The data showed that the SI students earned significantly higher grades, significantly higher average semester GPA higher retention rate, and a lower percentage of DFW grades than the non-SI groups of students. Also, a review was conducted of shifts in DFW grades with the same instructor of an economics course. The results revealed that longitudinal shifts of DFW grades from 1976-1980 showed consistent decreases in the years with an omission of results for 1976-1977 due to no services being provided. The DFW rate decreased from 34% in 1976 to 18% in 1980. Thus, SI utilization increased from 13% in 1978 to 45% in 1980 (Blanc et al., 1983).

Furthermore, Blanc et al. (1983) reported that there was a proportionate ratio of enrollment between the number of upper quartile students and lower quartile students. The top quartile SI students earned a higher average final course grade of 3.10, as compared to the non-SI students who earned average final course grades of 2.10. Similarly, the bottom quartile SI students earned higher average final course grades of 1.72, as compared to the non-SI students in this group with average final course grades of 0.88. Moreover, re-enrollment data revealed higher retention rates of SI students for Fall 1980 (77%) and Spring 1981 with 73% of the original 261 enrolled students continued enrollment from Spring 1980 as compared to Non-SI

Fall 1980 re-enrollment rate of 67% and Spring 1981 re-enrollment rate of 60%. The percentage of re-enrollment for the subsequent semester was higher for the SI students in both groups (Blanc et al., 1983).

Chemistry 2002 at San Francisco University. Rath et al. (2012) collected data on any student that participated in an SI workshop at any point during the period of the initial SI General Chemistry I (GC1) workshop offered from Fall 2000 to Fall 2006. During that time, over 2804 students enrolled in GC1 of which 499 students enrolled in SI workshops. During the six-year study, Rath et al. expanded the study to new SI courses that were offered which examined the impact of SI that was attached to four different chemistry courses: General Chemistry I (GC1) and II (GC2), and Organic Chemistry I (OC1) and II (OC2). The study investigated the differences in the impact of the SI services on underrepresented minority (URM) groups as compared to their peers. The results of the study showed that, of the four-course sequence, SI appeared to be most effective in the entry-level chemistry courses. In addition, the data on academic predictors revealed a relationship between SI participation and increased academic performance, showing higher pass rates and higher average course grades with all SI students including the URM students which included the GC1, OC1, and OC2 courses.

History of Student Engagement

Today, *engagement* is often used to represent constructs such as quality of effort and involvement in productive learning activities (Gonyea & Kuh, 2009). Typically, engagement has been measured by what individuals do and what institutions do to encourage and support individual student involvement. Kuh (2003) defined engagement as the time and energy students devote to academic activities as well as utilize support services offered by the institution. Likewise, Kuh, Kinzie, Buckley, Bridges, and Hayek (2006) described student engagement as the intersection of students' behavior and institutional conditions. Student behaviors may include time and effort invested in studies and interactions with faculty and peers, whereas institutional conditions involve educational policies, resources, academic support, programs, practices, and structural features. Svanum and Bigatti (2006) asserted that students' behaviors affect their learning and their prospect of achieving their educational goals.

Many research studies have focused on student engagement since this construct is an area of the college experience that represents student behaviors and performance that universities and colleges can address via proper assessments. Many studies have been guided by engagement theories of student success which emphasize student involvement in college and have proposed a distinctive view; success is guided by the extent to which students are engaged and involved in their college life. College success can be defined by performance outcomes, college persistence, and degree attainment (Svanum & Bigatti, 2009; Tinto, 1993).

The principle of engagement has been discussed in the literature for more than seven decades, with its definition developing through time (Astin, 1993; Gonyea & Kuh, 2009; Pace, 1984; Pascarella & Terenzini, 2005). The foundations of engagement have progressed with the work of Astin's (1993) theory of involvement, Pace's (1983) quality of effort scales, Vincent Tinto's (1993) Model of Retention, and Kuh et al.'s (1991) NSSE Instrument (Gonyea & Kuh, 2009). These scholars have contributed countless papers that have addressed various dimensions of student effort and time on task as well as their relationship to an assortment of desired college outcomes; all of these principles have been linked to student academic achievement and development in post-secondary education (Pascarella & Terenzini, 2005; Tinto, 1993).

Astin's theory of involvement. Alexander Astin (1984) popularized the quality of effort concept with his *theory of involvement*. About the same time, Astin (1999) contributed to the

Involvement in Learning report, which highlighted the relevance of involvement to student achievement. Astin's definition of student involvement connects student actions and scope of behaviors to theories of engagement (Svanum & Bigatti, 2009).

Svanum and Bigatti (2009) claimed that peer groups are essential to fostering student learning and personal development, and student change or growth is a result of college experiences. Astin's initial 10-year longitudinal study during 1966 revealed that students change after entering college and are affected strongly by three factors, including time of entry, type of college, and extent of college involvement. Engagement practices can be related to Astin's premise of college involvement. Although the results of the study declared that at least nine forms of involvement affect student change in several ways, for the current study, academic involvement and student-faculty interaction seem to be the most relevant to engagement of students enrolled in SI programs along with gateway mathematics courses. Astin (1977) described highly academically involved students as those who tend to devote considerable time to their studies and work hard. In contrast, low academically involved students tend to blame low interest and boredom on their courses and show little concern with grades. Ultimately, Astin asserted that high involvement was associated with good academic performance.

Quality of effort. In the 1970s, founded on 30 years of his research, C. Robert Pace created the College Student Experiences Questionnaire (CSEQ), which was grounded on what he termed *quality of effort*. Pace (1984) asserted that all learning and development that students gained from their educational experiences required an investment of time and effort by the student. Pace described time as a frequency element and defined effort as a quality where some educational practices required more focus of energy. The CSEQ instrument judged the quality of students' effort using a set of scales that measured activities in which students engaged. Pace assumed that some activities required more effort than others, possessing higher quality with greater potential for influencing learning or personal growth. The main focus of the CSEQ was investigating what students do during their college experience and what conditions in their experience influenced what they did and what they achieved. Pace argued that the measurement of quality of effort has pervasive value, demonstrating that the range or scope of high quality of effort is related to the range or scope of high achievement. Also, the breadth of involvement in the college experience and the breadth of attainment are linked, which implies that the more a person participates in his or her college experience, the more objectives he or she attains. Although the CSEQ questionnaire measures 142 activities within the 14 quality of effort scales and provides a systematic inventory of the campus experiences of undergraduate students, specific scales of the CSEQ related to intellectual development and social interactions can be associated with the student engagement factors that could be examined in this study. However, the researcher chose to integrate only the background information section of the CSEQ into the development of the survey of this study. These items are essential to connecting engagement factors to significant personal characteristics and different conditions in college such as age, major field of study, grades, etc.

Pace (1984) regarded education as both a process and a product. A process is defined as the procedures completed to accomplish the product whereas the product refers to intended outcomes such as knowledge acquired, skills improved, higher test scores and grades, and modified attitudes and values. SI is considered the process by which students develop learning strategies to progress toward the product of higher course grades, a lower percentage of course grades of DFWs, and higher rates of persistence, exemplified by re-enrollment in subsequent semesters and graduation (Martin & Arendale, 1992). Pace mentioned that the process or experience of students trying to understand how thoughts or ideas fit together in their learning experiences is a better experience than reaching the solution. This process connects with the construct of the SI model that integrates reasoning and study skills with the course content, which in turn allows students to form their conceptual frameworks for understanding what to learn and how to learn it (Martin & Arendale, 1992). Pace (1990) alleged that students acquired more from their college experience when they spent more time and energy on academic tasks such as studying, peer and faculty interaction, and application of learning to concrete situations and tasks; these activities align to some of the components offered through the SI model.

Tinto's model of student retention. Tinto's (1993) research suggests that students who integrate their college experience into both the academic and social dimensions of the institution are more likely to persist. A primary notion in Tinto's model is that students decide to depart from their educational program more often as a result of the college experience rather than pre-college experiences. Tinto believed that the institution has the responsibility to provide an environment that encourages students to become involved in the social and academic dimensions of the institution. Also, Tinto declared that,

> Classrooms are central to the process of retention and the activities that occur therein are critical to the process through which students come to participate in the intellectual life of the institution. The classroom is the place where students and faculty meet over matters of academic and intellectual substance. If we overlook the life of the classroom and the skills that faculty brings to bear to engage students in the classroom, where shall we turn to for enhanced retention? (p. 210)

According to Martin and Arendale (1992), "SI is designed to increase student academic performance and has an indirect positive effect on student retention and ultimate graduation" (p. 20). Also, Martin and Arendale asserted that "SI is a viable and effective option for changing the campus environment" (p. 46). SI sessions promote engagement in social interactions by enhancing involvement in learning and elevating the quality of student effort in the learning process which provides a promising vehicle for enhancement of student retention. Also, SI meets one of the most pressing challenges to the development of a sense of campus community which deals with ethnic diversity of entering college students; the SI sessions allow students to become less isolated and are helped to assimilate into the culture of the institution, both academically and socially (Martin & Arendale, 1992; Tinto, 1993). Since the SI setting is structured to bring different students together to work on a common task, the environment creates opportunities for students to work with others outside of their cultural groups for the first time. Martin and Arendale (1992) believe the SI experience can help break down some stereotypes and allow students to discuss and share culturally diverse points of view.

National Survey of Student Engagement. Kuh (2003) asserted that "the effort by National Survey of Student Engagement (NSSE) has made it an axiom that what matters in student outcomes is student engagement in college activities" (p. 751). However, this approach places more responsibility for student engagement on administrators and less on the instructional faculty. The NSSE was designed with three core purposes: institutional improvement, public advocacy, and documentation of good practice. Data from the NSSE were used to determine areas of institutional programs where changes in policy and practices could enhance student engagement (Gonyea & Kuh, 2009). Also, the NSSE was designed to provide reports of benchmark results so that universities could compare results with similar schools; the data were used to inform planning, assessment, and improvement of institutional policy and practices. The benchmark results of the NSSE were geared to shed light on aspects of the student experience that linked engagement to student learning and what undergraduates gained from their overall college experiences. Furthermore, the NSSE was structured to measure the amount of time and energy students devoted to academic activities and assess how institutions used resources to prompt students to engage in activities that increased their learning experiences. However, Svanum and Bigatti (2006), Burch et al. (2015), Lee (2014), and Handelsman et al. (2005) proposed that the NSSE was not the best instrument for evaluating student engagement and relating the academic performance of students. Handelsman et al. (2005) declared that the use of the NSSE was not a relevant tool to assess academic course engagement since it was developed at the macro level to compare universities to one another; therefore, the results of the NSSE survey connected student engagement to the college/university level. Thus, it is difficult for researchers to differentiate and associate results of the NSSE to engagement of students at the course/class level. Consequently, the results of the NSSE are limited in providing student engagement information for educators, faculty, individual programs and academic departments, and researchers to conduct evaluations of student learning outcomes and performance at the micro level relating to the courses. Accordingly, educators have been prompted by the need to evaluate how class elements affect student engagement, which leads to most recent research on academic course engagement (Svanum & Bigatti, 2006).

Academic Course Engagement

Handelsman et al. (2005) conducted a study to assess student engagement in college courses with a focus on lower division courses. They believed that the faculty could make the greatest difference with and had the most control over student performance within the classroom. Furthermore, Handelsman et al. (2005) alleged that instructors had a significant influence on student behavior and feelings in the classroom, asserting that social interactions between the instructor and students are important to the student experience and increased learning. Burch et al. (2015) believed that student engagement in the business education courses at Tarleton State University was a focal point of quality improvement of the program. Therefore, faculty members of the business program were challenged to explore ways to measure student engagement in the courses and to advance research in student engagement. Burch et al. (2015) considered student engagement in academic courses to be among the better predictors of student learning and development. Burch et al. (2015) argued that past research focused on institutional influences of student engagement measured by the NSSE, but the business colleges of Tarleton University required course and class student engagement data to demonstrate continuous program improvement. Also, Burch et al. (2015) expressed that other researchers called for more reports of granular data to generalize conclusions about connections between instructional practices and student engagement and links of student engagement to learning relationships. Thus, the focus of Burch et al.'s (2015) research was to develop and validate an instrument to measure the applications of Kahn's model of employee engagement research to student engagement in the business courses. Research data has shown that increased academic course engagement has presented positive relationships of improvements in student learning (Pascarella & Terenzini, 2005).

Svanum and Bigatti (2006) asserted that college success is the product of joint influences of the student's effort in courses during semesters and throughout his/her college career. Also, Svanum and Bigatti (2009) believed that academic course engagement during a semester forecasts college success. Moreover, Svanum and Bigatti (2006) agreed with Astin (1993) that "Contemporary models of student learning emphasize student engagement and effort as important variables in course success" (p. 564). Also, Svanum and Bigatti (2006) focused research interests on student effort as an important component of course success and found that course attendance and study time had a significant impact on semester GPA. Finally, Robbins, Lauver, Le, David, Langley, and Carlstom (2004) aggregated 37 analyses reported in 31 studies, determined that academic course engagement is a viable predictor of college success. Most of the instances reported academic performance as a predictor of success.

Theoretical Framework: Self-Theories and Goals

This study was conducted through the lens of four factor constructs of student course engagement as determined through the validation of the Student Course Engagement Questionnaire (SCEQ), designed and tested by Handelsman et al. (2005). During the early stages of scale development for the SCEQ, Handelsman et al. (2005) started with seven factors of engagement, but they settled on the four factors that best accepted the load of the original 27-item SCEQ onto an exploratory factor analysis. Also, the four factors best fit the inspections of the scree plot slopes. The four factors of student engagement included: skills engagement, participation/interaction, emotional engagement, and performance engagement. Through the validity study of the SCEQ, Handelsman et al. (2005) found relationships among the four engagement factors and the theoretical frameworks of self-report measures of engagement, endorsement of self-theories, goal performances, and grades. The initial assessment of construct validity of the SCEQ was examined through three measures.

First, Handelsman et al. (2005) conducted a correlation of self-report of participants with their engagement levels and related the results to two types of engagement: absolute engagement, which refers to engagement in the current course, and relative engagement, which compared levels of engagement in other courses to the current course. Handelsman et al.(2005) regressed the absolute engagement and relative engagement on the four student course engagement factors and found that emotional engagement was a positive predictor of relative engagement.

Secondly, the SCEQ was based on the work of Dweck and Leggett (1988), which classified students according to self-learning theories of intelligence as entity learning or incremental learning. Dweck and Leggett (1988) described entity learning as the self-belief that the learner has a predetermined capacity for learning, whereas incremental learning involves the learner's belief that the capacity for learning can be extended. Students with the entity learning point of view often have displayed the cognitive, affective, and behavioral components of a helpless response, whereas, the students with the incremental point of view have displayed the more mastery-oriented reactions. Students who hold an entity learning point of view tend to believe that working hard makes them feel stupid and that the effort they exerted would not benefit them since they believe their ability level is low; these students often experience feelings of distress and shame about their poor academic experience and tend to give up easily in challenging situations. In contrast, incremental learners have associated greater effort with better performance outcomes. In addition, students possessing an incremental point of view are less prone to doubting their abilities when challenged with difficulties and tend to persist and show more diligence with higher, sustained effort; Dweck and Leggett (1988) concluded that these students earned the higher grades in their college courses. The SCEQ instrument is aligned with the self-theory model, which helps people to identify the "specific cognitive, affective and behavioral processes that they engage in as they strive to validate or expand their attributes and competencies" (Dweck, 1999, p. 138). Handelsman et al.'s (2005) SCEQ validation study investigated the role of self-theories by regressing the incremental beliefs on the four student course engagement factors which revealed that emotional engagement was a positive predictor of incremental theory beliefs.

Third, Dweck (1999), Dweck and Leggett (1988), and Molden and Dweck (2000) proposed a social-cognitive model that delineated a motivational pattern of mastery. Through several studies, they discovered that children set learning goals that are often intrinsically motivated and are related to increased competence (i.e., mastery), whereas others set performance goals that are extrinsically motivated and focus on gaining favorable judgments of their competence, such as earning good grades. Dweck's (2000) research claimed that certain goals are central to people's functioning in their intellectual and social lives. It also demonstrates how certain self-theories can emphasize one class of goals relative to the other.

Dweck's (1999) self-theory model focuses on the self-beliefs and self-relevant goals that people develop. Dweck (1999) asserted that performance goals are critical to achievement, and sometimes students experience problems when proving their ability becomes so important that it drives out learning goals. Also, other problems surface when students attach their intelligence to their measurement of ability; consequently, the performance goals may propel them into helpless responses. Similarly, Sansone and Harackiewicz (2000) claimed that individuals approach and perform activities with some idea about what they want to accomplish, which they refer to as perceived goals. Perceived goals are composed of target goals and purpose goals; individuals set target goals to accomplish the performance of an activity and set purpose goals to reflect why they are engaging in the activity. Thus, Sansone and Harackiewicz concluded that students frequently rely on extrinsic and intrinsic motivators based on their perceived goals. When Handelsman et al. (2005) asked students to choose between getting a good grade and being challenged, they found that there was an even split in the responses; thus, they concluded that categorizing students with learning goals or performance goals did not show that students have only one goal preference. Handelsman et al. (2005) conducted a multivariate analysis of variance on the four engagement factors which assigned goal orientation as the independent variable. The data analysis revealed a statistically significant effect of goal orientation and the univariate analysis showed that the students with a learning orientation were more emotionally engaged.

Conceptual Framework: Factors of Engagement

Several research studies have demonstrated that engagement is not a single-dimension construct. Burch et al. (2015) proposed that four factors of engagement are related to student learning and performance of the course; they found that students can be emotionally engaged, physically engaged, cognitively engaged in class, and cognitively engaged out of class. These constructs were based on Kahn's (as cited in Burch et al., 2015) employee engagement research, in which he contended that employees were willing to invest emotional, physical, and cognitive resources in their performance of roles. Likewise, Handelsman et al. (2005) conducted two studies, the exploratory analysis of which revealed four dimensions of college student engagement: namely, skills engagement, participation/interaction engagement, emotional engagement, and performance engagement. Lee (2014) asserted that engagement is a multifaceted concept that involves behavioral, emotional/psychological, cognitive, and academic components, arguing that "the effect of student engagement on academic performance varied depending on the components of engagement that are examined" (p.178).

For this study, the researcher chose to focus on Handelsman et al.'s (2005) four constructs of factors of student course engagement. In comparison with the other available constructs, the researcher believes that Handelsman et al.'s (2005) four factors were most relevant to what college mathematics students are required to do with their coursework in order to earn a satisfactory grade. In addition, this study focused on student engagement in college gateway mathematics courses, which is related to one of Handelsman et al.'s original studies that focused on undergraduate students enrolled in a liberal art mathematics course attended by students who majored in a variety of subjects.

The Four Factors of Student Course Engagement

Skills engagement. The student puts forth academic effort in activities such as completion of homework assignments, completing reading assignments, use of note-taking strategies, and study skills strategies. Similarly, these behaviors can be aligned with physical engagement, which Burch et al. (2015) described as behaviors where the student works intensely on assignments, exerts full efforts in class, and exerts lots of energy towards the course; researchers have reported that skills engagement is reliably related to various measures of college success. Robbins et al. (2004) classified over 100 studies within nine constructs that related to college success; one of the constructs, academic related skills, was defined as "activities necessary to organize and complete schoolwork tasks, and to prepare for and take tests" (p. 264).

Likewise, Handelsman et al.'s (2005) first factor of engagement, skills engagement, was found to relate to college performance, and somewhat surprisingly, even more strongly to retention. In addition, based on the research of Svanum and Bigatti (2009), the level of student academic engagement and effort in coursework—such as attending class, reading, reviewing course material, etc.—affects not only course success as measured by grades, but also other indicators of college success including degree completion. Students often view course performance, especially low grades or failure, as a consequence of course effort. Furthermore, academic-related skills demonstrated incremental validity in predicting retention (Handelsman et al., 2005). The connections of skills engagement to the SI model are described in more detail in a subsequent section of this literature review.

Participation/interaction engagement. The student is involved with interacting with professors, participating in class discussions and activities, asking questions, raising his/her hand, and helping fellow students. Student-faculty interactions are important because they encourage students to put forth the effort to become personally engaged in their academic progress (Kuh et al., 2006; Pace, 1984). Making more formal contact with faculty members out of class—such as discussing ideas about a term paper or project, career plans, and other topics—often requires more student initiative; thus, they exercise more effort, which results in constructive educational experiences for students in their academic development and performance (Pace, 1982).

Ultimately, the more students interact with faculty, the more likely they are to enhance their learning and persist towards achievement of their educational goals. Gonyea and Kuh (2009) conveyed that personal interaction with faculty members strengthens students' connections to the college and helps them focus on their academic progress. Also, as students collaborate with an instructor on a project or serve with him or her on a college committee, it allows the students to view how the faculty recognize and solve practical problems. Through these interactions, faculty members serve as role models, mentors, and guides for continuous, lifelong learning (Gonyea & Kuh, 2009).

As students participate in SI courses, they can interact with the SI leader who models strong study practices. Since the SI leader is required to attend the lecture courses, take notes during the lecture, and complete the readings of the lecture courses, he/she can align the study activities of the SI sessions with the content of the lecture course (Martin & Arendale, 1992). As a result, the SI leader and the faculty become the role models, mentors, and guides for the SI students (Gonyea & Kuh, 2009).

Astin (1993) asserted that peer interactions are highly influential on every facet of development, including cognitive, affective, psychological, and behavioral domains. Kuh et al.

(2006) asserted that "students' interactions with their peers can influence overall academic development, knowledge acquisition, and analytical and problem-solving skills" (p. 42). Furthermore, Pascarella and Terenzini (2005) discovered that social interactions with peers may enhance learning and performance when these interactions are related to the academic environment.

Research suggests that students who work in collaborative learning groups have an opportunity to actively engage in discussion with their peers, which develops their critical thinking skills and helps to build self-efficacy (Johnson & Johnson, as cited in Martin & Arendale, 1992; Smith, as cited in Martin & Arendale, 1992). Through the active and collaborative learning benchmark of the NSSE, Kuh (2009) noted that:

> Students learn more when they are intensely involved in their education and asked to think about what they are learning in different settings. Collaborating with others in solving problems or mastering difficult material prepares students for the messy, unscripted problems they will encounter daily during and after college. (p. 17)

Tinto (1993) asserted that collaborative learning is as important as the content and opportunities for active engagement in education activities during a student's first year in college in terms of promoting student learning and retention. SI provides a natural setting for the involvement of first-year students with their peers and veteran students. For example, the SI leader helps them focus on their academic work, and SI sessions give students more time to spend together to review course content in a structured, effective session that involves others (Martin & Arendale, 1992).

Emotional engagement. Studies using emotional engagement with behavioral engagement have found positive relationships between engagement and academic performance. Also, research has supported the significant influence of emotional engagement on the decision to drop out, especially when students lack a sense of belonging to the school (Lee, 2014). In a study of 214 Mexican American high school students, researchers found that the level of students' sense of belonging was significantly associated with their GPA (Gonzalez & Padilla, as cited in Lee, 2014). Furthermore, Lee (2014) conducted a study on reading performance, finding that behavioral engagement (defined as effort and perseverance in learning) partially mediates emotional engagement. The results showed that putting forth effort and perseverance in learning were prerequisites to student learning, especially difficult material.

The student displays engagement through emotional involvement with the class material. Also, Burch et al. (2015) alleged that emotional engagement is sometimes demonstrated through enjoyable states of mind; this may be experienced through peer interactions in group activities. Furthermore, emotionally engaged students experience feelings of enthusiasm about the course, express interest in the material, feel positive about completing the assignments, and/or feel excited about attending the course (Burch et al., 2015; Finn, as cited in Lee, 2014; Willms, as cited in Lee, 2014). Also, the student finds ways to make the course interesting and relevant to his or her life (Burch et al., 2015; Handelsman et al., 2005). Moreover, this emotional engagement factor involves the students' level of confidence, the level of thoughts about the class while out of class, the application of the course material, and the desire to learn the course material. SI is particularly effective in fostering self-confidence and self-esteem as students experiment with new learning strategies during the SI sessions without worries of formal evaluations or assessments. As students gain supportive feedback from the SI leader and other SI students and receive higher grades in the attached high-risk course, their self-esteem spirals upward (Martin & Arendale, 1992). Handelsman et al. (2005) believe that helping students become emotionally engaged may be an effective complement to teaching knowledge and skills.

Performance engagement. "Researchers have found that goal orientation predicts different learning strategies and academic achievement" (Handelsman et al., 2005, p.185). The learner sets goals to perform well on the test and he or she expresses the desire to earn good grades. Most students view coursework pragmatically, which means that their goal, with some exceptions, is to achieve the highest possible grade and then move toward completing their degree program. However, many students regard difficult courses as a hurdle to get over, and sometimes when they believe they may not achieve a desired grade without assistance they limit their commitment to sufficient study time. Thus, several research studies have shown a positive relationship of high levels of participation during the SI courses to their actual or perceived course performance (Martin & Arendale, 1992).

Likewise, within the items of the performance engagement factor, the learner is concerned with confidence levels of the ability to learn and do well in class. Hence, researchers have found that cognitive engagement is displayed during the performance of various activities, such as devoting a lot of attention to class discussion and being absorbed by class discussions and activities (Burch et al., 2015). However, Molden and Dweck (2000) have found that performance goals suffer most from failure; subsequently, the relationship between grades and engagement may lower after a failure experience during the course (Handelsman et al., 2005).

Connecting the Student Engagement Factors to the Supplemental Instruction Model

Handelsman et al.'s (2005) four engagement factors can be connected to the SI model, which includes several student-centered activities that encourage students to engage in learning the content of the high-risk courses. This section of the literature review describes the opportunities for students to participate within the constructs of the engagement factors. The researcher reviewed several SI leader handbooks from universities that provide training for SI leaders to facilitate learning in the SI sessions.

Skills engagement. During the SI session, the SI leader employs various active learning study techniques, including: reading and marking the textbook for key information, visual techniques such as mapping and picturing to help students understand the relationship between topics covered in various lectures, creating note cards to organize the lecture notes, developing mnemonic devices for memory of content, and vocabulary activities to understand key concepts. Also, the SI leaders are trained to provide review worksheets of key concepts (Curators of the University of Missouri, 2005, 2014).

As outlined in the NSSE, accurately assessing the level of academic challenge is a significant factor to advancing academic student engagement. Challenging intellectual and creative work is central to student learning and collegiate quality (Gonyea & Kuh, 2009). Thus, the goal of the SI model is to provide academic sessions that emphasize analysis, synthesis, and application of theories and concepts; SI leaders are trained to engage the students in learning key concepts.

SI participants have opportunities to encounter various study strategies such as note taking, active reading, graphic organization, vocabulary acquisition, problem-solving, and test preparation to review subject matter. Students can become involved actively in the course material when SI leaders show them how to use the text, take lecture notes, and use the readings as tools in refining skills for learning. Some of these skills are often referred to as *self-regulated learning skills.*

Self-regulated learning is defined as “the ability for students to actively regulate cognitive, motivational and behavioral learning processes in attaining their academic goals.”

(Heller & Marchant, 2015, p. 3). Learning strategies related to self-regulation and building self-efficacy include cognitive development with effective note-taking skills, efficient use of study strategies, and efficient management of time. In addition, these strategies can be applied to test preparation techniques for increased performance on assessments of student learning (Heller & Marchant, 2015). It is common for students with low academic ability and a lack of essential study skills to be at risk of failure, which leads to potential decisions to drop out. Heller and Marchant (2015) found a strong correlation in the differences in academic performance between low achieving and high-achieving students with the ability to self-regulate. Cukras (2006) recommended that first time college students be offered academic assistance to help them become independent, self-regulated learners.

Lack of academic skills contributes to poor student performance, high failure rates, and withdrawal from courses for older as well as younger students. Similarly, Goldfinch and Hughes (2007) discovered that faculty members often express their concerns about poor academic performance as linked to students' effective and efficient use of study strategies. Cukras (2006) recommended that students develop an inventory of study strategies to learn material and apply to assignments which is essential for student learning and understanding of the material. As students implement organizational skills to properly utilize the materials to understand concepts, then the students may increase their knowledge of the material, thus they could potentially improve their academic performance in the course. Furthermore, to help students improve learning of new material and retain concepts, Boelkins & Pfaff (2007) recommended that students should spend an average study time of 2 hours a day with structured and consistent study time.

Adults self-regulate better and more often with simple material more than with difficult material. Students with greater background knowledge of material tend to be more selective of the key information that is presented, therefore, they take fewer notes. However, students should develop note-taking strategies that include reading for information, critical thinking, and analysis and synthesis of information. As a result, effective note-taking strategies such as Cornell Notes may guide students more thoroughly, which may help them process information efficiently. In the end, proper application of the Cornell note-taking technique increases an awareness of what is learned and what information needs to be reviewed (Peverly, Brobost, Graham, & Shaw, 2003).

Poor time management commonly contributes to student failure and drop out; however, efficient study time often requires less frequency of study sessions (Landrum, Turrisi, & Brandel, 2006). Besides daily planning, the long-term planning aspect of time management seems to contribute to the success of first-year students. More time spent with studies correlates to satisfactory student performance. Students must design the map of their time to balance every aspect of their lives, especially academic studies, their career, and their personal lives (Cavanaugh, Hargis, & Mayberry, 2016).

Frierson (1986) mentioned that college students typically have a poorly defined metacognitive sense of how prepared they are for an examination; they also have a poor sense of how well they performed on an exam. On average, students have difficulty applying the appropriate strategies for answering different types of questions, including multiple choice and open-ended types. Similarly, students are challenged with various types of comprehension questions that require memory and inferential background knowledge. Accordingly, students who apply effective reading strategies to synthesize the stated information may develop better understanding of the material and improve their memory of the content which may help them respond better to the different structures of exams. (Peverly et al., 2003).

Participation/interaction. Math SI sessions emphasize student interaction while reviewing the course content and working on problems. SI leaders are trained to promote interaction and encourage students to help each other. SI leaders are trained in various collaborative learning techniques to facilitate discussions among the students. The SI leaders must find ways to involve SI participants with the course material via collaborative learning techniques such as group discussions, clusters, think-pair-share, jigsaw, and problem-solving sessions (Curators of the University of Missouri, 2014).

Group discussion is one of the most common activities associated with collaborative learning; therefore, it is important for SI leaders to be properly trained in the dynamics of facilitating a successful group discussion in order to get the maximum involvement of the group members. Using clusters is a good way to change the interactions within a group. Breaking people into smaller groups accomplishes several goals; it makes them more accountable, promotes active processing of material, and encourages participation by everyone. Think-pair-share, which requires students to work in pairs on an assignment or discussion problem, is a fast and efficient way of getting everyone involved in the discussion. Also, this technique helps students discover different ways to solve similar problems while helping each other. Research shows that whoever does most of the talking also does most of the learning. Also, the brain has to work just as hard to articulate something to one person as it does to 10 people, so working in pairs is a powerful way of getting everyone's brain working at the same time. When used properly, jigsaw activities make the group as a whole dependent upon all of the subgroups, which makes all of the members accountable for learning the pieces of the content puzzle (Curators of the University of Missouri, 2005, 2014).

Collaborative activities are beneficial to review material from problem-solving courses like chemistry, physics, or mathematics are typically major obstacles for many students. Students often experience challenges finding the best approach to solving a problem, and most instructors of large lecture classes spend little or no time demonstrating problem-solving strategies in class; thus, SI creates a haven for students to learn these skills through collaborative activities. During SI sessions, participants are encouraged to collaborate with each other in small groups to find the best strategies to solve the problems. (Curators of the University of Missouri, 2005, 2014).

Performance engagement. Since the grades for gateway mathematics are typically weighed heavily on exam performance, one major focus of the SI session is exam preparation. SI leaders are trained to utilize several techniques for exam preparation, including informal quizzes, prediction of test questions, practice exams, exam review sessions, exam format reviews, and post-exam surveys. The informal quiz is a procedure that is educationally compatible with the goals and objectives of the SI model and helps students put all of the course's important ideas together (Curators of the University of Missouri, 2005, 2014). The "quiz is used to develop and reinforce comprehension, improve retention of information, stimulate interest in a subject area, and promote student participation in the study session" (p. 43). The informal quiz enhances the educational experience and promotes student engagement in several ways. First, it allows struggling students to participate equally with other students to determine the best solutions to the problems. Secondly, it permits each student an opportunity to demonstrate competence. Third, it promotes students' self-testing of their comprehension level. Fourth, it provides the SI leader a chance to reinforce student participation. Fifth, it allows students to work with test material in a cooperative rather than competitive way. Finally, it facilitates students' ability to interpret, answer, and predict test questions (Curators of the University of Missouri, 2005, 2014).

As students prepare for their exam, the SI leader helps them develop the skill of predicting test questions, which can help students build their confidence during the study groups. This type of activity is useful shortly before an exam when a large number of non-regular participants attend the SI study sessions. Also, SI leaders are trained to help students identify the exam format by discussing the types of questions to expect on exams that typically include: multiple choice, true/false, essay/open-ended, and matching. Moreover, the SI leaders emphasize techniques to understand keywords used in exams. Finally, post-exam surveys are administered after the exams to encourage student self-reflection of performance and help them focus on the effective strategies they used to prepare for the exams. Since each student has a unique pattern of the types of errors he or she makes during examinations, then each student is taught how to self-discover those patterns to help him or her self-correct. The primary goals of engaging students in this exercise of self-assessment are to boost learning and achievement and promote academic self-regulation (Andrade & Valtcheva, 2009).

Emotional engagement. Students frequently feel overwhelmed by the sheer volume of information that they have to manage during the term; therefore, SI sessions give students an opportunity to reflect on areas in which they need to improve. SI leaders are trained to form positive relationships with the SI students, which is essential to the success of the SI program. The SI leader must create an environment for students to feel welcomed, accepted, and believed. Also, SI leaders are trained to maintain a trusting climate for students to ask questions, attempt answers, feel protected from interruptions, laughter, or from those with louder voices (Curators of the University of Missouri, 2005, 2014).

Gateway Mathematics Courses

Most undergraduate programs, especially STEM programs, require at least one mathematics course for degree completion; often these mathematics courses are introductory level courses, called *gateway mathematics* or *gatekeepers* (Chen & Soldner, 2013). College level math courses include, but are not limited to, gateway mathematics courses, algebra and number theory, geometry, computational mathematics, financial mathematics, and calculus (Radford & Horn, 2012). Gateway mathematics courses have been considered one of the barriers to student persistence. In addition, these courses have contributed to high attrition rates due to the high percentage of course failure, high course withdrawal rates, large lecture courses, and lack of student engagement (Chen & Soldner, 2013; Gasiewski, Eagan, Garcia, Hurtado, & Chang, 2012).

Attrition. Research has shown that within the first 2 years of taking gateway courses in the sciences, high attrition rates occur (Chang et al., 2008). For example, Chen and Soldner (2013) reported that during the entry year of 2003-2004, a significant percentage of bachelor level students withdrew from and or failed STEM courses during their first year of enrollment. The data showed that 24% were STEM students who dropped out, 15% were first-year STEM entrants who switched majors, and 11% were first-year STEM entrants who persisted to completion of a degree or certificate by 2009. There is substantial evidence that attrition follows poor grades. For example, Chen and Soldner revealed that among 2003-2004 first time postsecondary students with transcripts, 76.9% of STEM majors attempted any college-level math course during their first year of college; however, the average math credits earned were

12.7 and the average math GPA was 2.9. Yet, only 57% of the students enrolled in non-STEM fields attempted any college-level math course during their first year of college and earned an average of 4.5 math credits with an average math GPA of 2.6. Similarly, of students in undeclared majors and not in a degree program, 50.2% attempted any college-level math credits, with an average of 4.4 math credits earned and an average math GPA of 2.5.

Retention. Recent research has suggested a strong correlation between GPA and persistence in college; students tend to persist when their grades are satisfactory. Whalen, Saunders, and Shelley (2010) reported that students with higher GPAs by the end of their first year returned at a significantly higher rate than students with lower GPAs. Furthermore, Budney, LeBold, and Bjedov (1998) disclosed in a study of Purdue freshmen that there was a positive relationship of higher first-semester GPA to higher rates of retention. Budney et al. (1998) further examined the grades in the first-year students' first mathematics course which the results revealed that the grades were a predictor of the likelihood of retention. In fall 2003, Belcheir (2005) found that the best predictor of first-time-in-college students re-enrolling in courses after 1 year was their first-semester GPA. Similarly, Belcheir (2006) showed that the first-semester GPA was the only variable needed to predict retention. The research revealed that the variables most predictive of first-time, full-time students who enrolled 1 year later included a grade of A or B in their mathematics course, a grade of B in their English course, and enrollment in an English course beyond freshman English.

Also, Belcheir (2005) reported that although course level was significant, the grades earned were more significant predictors of persistence after 1 year of enrollment. Also, Belcheir (2005) discovered that the mathematics grade was a better predictor of continued enrollment than the level of mathematics course taken. For instance, Belcheir (2005) found that even though students who entered their first year at a mathematics level of calculus I or higher were more likely to persist than students beginning at levels below calculus I, they concluded that the strongest predictor of retention was grade earned rather than course level. Similarly, Budney et al. (1998) reported that students who earned an A grade in pre-calculus in their first mathematics course showed approximately the same retention rate as students who earned a B grade in calculus I in their first mathematics course. Similarly, students who received a C in calculus II as their first mathematics course showed approximately the same retention rate. Likewise, Adelman's (2006) study disclosed the significance of earning college-level mathematics credits within the first 2 years of enrollment as a predictor of degree attainment. Chen and Soldner (2013) compared the highest level of math course taken by STEM and non-STEM students at the bachelor level from 2003-2009. For instance, 81% of STEM students who persisted to a degree or certificate completion took advanced mathematics courses and 15% took introductory courses. In contrast, 36% STEM students who dropped out took advanced courses and 34% chose introductory level courses, whereas 57% STEM entrants who switched majors took advanced mathematics courses and 33% STEM entrants took introductory mathematics courses. Similarly, 52% of non-STEM students took more introductory level mathematics courses and 23% non-STEM students took advanced mathematics courses.

Also, during the 2003-2004 first year entry into bachelor's degree level programs, many students in non-STEM programs showed less commitment to STEM courses than STEM students as reported by lower enrollment and less earned credits during the first year. For instance, 83% of non-STEM students took STEM courses, of which 77% earned STEM credits compared to 100% of the STEM students who persisted to completion of a degree or certificate;

the students that took STEM courses: 99% of them earned STEM credits. Likewise, the data for college-level math course enrollment showed similar correlations.

Predictors of success. Gupta, Harris, and Carrier (2006) conducted a study on predictors of success of gateway mathematics 100-level courses as a response to reports from 2001 at the University of Southern Maine that showed 20.7% failure rates for specific entry 100-level mathematics courses compared to a 9.6% failure rates for all other 100-level courses across the university for the same term. As a result of the study, Gupta et al. (2006) found that the students who received higher grades included those who: were male, were older non-traditional students, had positive attendance, had taken more 100-level classes, attended 1-week format classes, had a more positive attitude toward mathematics, and had a lower ranked instructor.

Gupta et al. (2006) concluded that students who took mathematics classes that met once a week received better grades due the possible impact of student motivation to earn their grades. They believed that more serious students that had other life responsibilities and made sacrifices were more likely to attend class; thus, fewer missed classes may have helped them earn better grades. Regardless of the reason, Gupta et al. (2006) determined that academic success in the mathematics classes was linked to positive class attendance.

Engagement in STEM courses. Levels of student engagement are often affected by the typical large lecture class format of most STEM gateway courses. Students regularly experience increased academic difficulties and feelings of discouragement due to difficulty learning the content and poor success levels in these courses (Gasiewski et al., 2012). Of particular interest to this study is student engagement in STEM courses; therefore, the researcher reviewed the a mixed method study conducted with 2,873 students enrolled in over 73 introductory STEM courses across 15 colleges and universities. The findings shed light on engagement factors that students self-reported that have significantly influenced participation in their learning of the STEM gateway course content. Some of the quantitative data collected included student demographics, college enrollment level, pre-med status, and predictors such as SAT scores, etc. which Gasiewski et al. (2012) found had low impacts on student engagement in the STEM courses. Freshman reported higher engagement than students who had been in college a longer period; Gasiewski et al. (2012) concluded that students who wait later in their college career to take STEM courses are likely to be less engaged. Students who felt excited about learning new concepts self-reported higher levels of engagement in the classes. Gasiewski et al. (2012) determined that the findings implied that students who possessed a genuine interest in learning rather than the desire to earn the best grades had significantly higher engagement levels.

Also, Gasiewski et al. (2012) found more significant indicators of student engagement through the survey of several engagement factors. At least seven survey items on the list of quantitative engagement factors were similar to some of the items of the SCEQ. For example, six items were related to the participation/interaction engagement subscale of the SCEQ; these items asked whether the participants: asked questions in class, met with the professor during office hours to discuss grades, and participated in class discussions. One item was related to the skills engagement subscale, i.e., reviewed class material before it was covered.

Furthermore, the findings of the study showed that students who described the introductory course as more lecture-based reported significantly less engagement in the course; students described that they experienced feelings of disengagement and non-enthusiasm for the course as they sat through the mindless lectures from the professors. Students reported more engagement in the course when more time was spent on class discussions and group work and more opportunities to connect with the professors inside and outside the classroom.

Gasiewski et al. (2012) found that collaboration among peers positively predicted levels of student engagement in the STEM course. Tag (as cited in Gasiewski et al., 2012,) asserted that “more active student learning with peers provides a context that enhances students’ connection and interest in class” (p. 245). Many students self-reported that a collaborative environment in their introductory course encouraged them to engage more fully. Similarly, students were more inclined to attend SI sessions if other students from the course joined them; several students expressed that if the SI leader did not cover specific material or they did not understand the SI leader, then they could rely on asking their peers to fill in the gaps of content for better understanding. Students who attended more SI sessions have reported they experienced more engagement in their introductory courses. Students reported that they sought the SI classes for additional instruction when they felt they did not understand the course content during the lecture sessions of the course. Students reported that attendance in the SI sessions helped them understand the course content, which increased their confidence to engage more in the lecture sessions of the introductory courses.

Summary of Literature Review

This chapter presented a review of the literature with several sections related to SI, student engagement, and gateway mathematics courses. The historical background on SI has shown the rapid expansion of thousands of effective SI programs at various colleges and universities across the United States and abroad over the course of 4 decades. Also, the review of research on the implementation of SI programs in at-risk courses, especially in STEM fields, has revealed significant positive impacts, yielding higher grades and increased retention for SI participants as compared to non-SI participants. Furthermore, the review of literature addressed the connections between Handelsman et al.’s (2005) four student engagement factors of skills engagement, participation/interaction engagement, emotional engagement, and performance and opportunities for student participation in activities offered through the SI model. Handelsman et al. (2005) relied on Dweck's (2000) self-theories of intelligence and goals to guide the development and validation of the SCEQ instrument that was used in this study. Dweck (2000) reported that students' views of entity learning and incremental learning affect their level of effort, performance goals, and learning goals. The SCEQ requires participants to reflect on their behaviors, thoughts, and feelings on items within the four engagement factor subscales; results were used to determine relationships to the participants' grades in the gateway mathematics courses. The review of literature has shown that the highest rate of attrition typically occurs during the first 2 years of enrollment in science courses. Also, the literature indicates that STEM students and non-STEM students who earn higher grades, especially in gateway mathematics courses, during their first year of college demonstrate more persistence in earning course credits toward program completion. Moreover, students have self-reported higher levels of engagement with participation in SI sessions, active learning opportunities, and faculty and peer interactions within the STEM gateway lecture courses. The information gathered in this literature review has provided the researcher with a foundation of valid principles that supported the study of the research questions and guided the research methods, the design of the survey instrument, and the procedures of data analysis throughout this study. In Chapter 3, the researcher describes several components of the research methodology, the target population, sampling, sample size, and human subject considerations.

Chapter 3: Research Methodology and Procedures

This chapter presents a description of the methods employed in this study, including research questions, hypotheses, research design and rationale, setting, target population, sampling and data collection methods, human subject considerations, measures and instrumentation, data analysis and interpretations, and data management. The chapter concludes with a description of the researcher's positionality.

Purpose and Nature of the Study

The purpose of this quantitative correlational survey study, conducted at CSU, was to investigate engagement factors employed by SI students enrolled in gateway mathematics courses. Also, this study explored the relationships of the SI students' engagement factors to their gateway mathematics course grades.

For this study, the researcher employed a survey design. The researcher examined correlations between the academic course engagement factors and grades of students enrolled in SI math courses while concurrently enrolled in gateway mathematics courses. The variables of student engagement factors and academic performance were measured in the conative and cognitive domains respectively. Data regarding student engagement were collected cross-sectionally during one semester and analyzed at the interval level of measurement with the use of several Likert-scale survey questions from a web-based survey that was adapted from the SCEQ. Data regarding grades earned for completion of the gateway mathematics course were collected cross-sectionally and analyzed at the ordinal level of measurement.

Research Questions.

To develop a better understanding of the effects of student engagement factors on course grades of students enrolled in a gateway mathematics course, the following research questions were explored with SI students at CSU in Southern California.

1. To what extent, if at all, are any of the SI students' academic course engagement factors individually related to their gateway mathematics course grades?
2. To what extent, if at all, is the linear combination of the SI students' four academic course engagement factors related to their gateway mathematics course grades?

Hypotheses (alternative).

Ha1: At least one of the four academic course engagement factors is related to the students' gateway mathematics course grades.

Ha2: The linear combination of the four-course engagement factors is related to the students' gateway mathematics course grades.

Hypotheses (null).

Ha1: None of the four academic course engagement factors are related to the students' gateway mathematics course grades.

Ha2: The linear combination of the four-course engagement factors is not related to the students' gateway mathematics course grades.

Research Design and Rationale

This researcher employed a quantitative correlational survey design to investigate the relationships between student engagement factors and gateway mathematics course grades among college students enrolled in a SI course that was attached to the target gateway mathematics course. Quantitative research involves the collection of conclusive data, such as numerical data, so it can be examined in a scientific method to provide explanations of relationships among variables (Creswell, 2009). The survey included 13 background questions, 23 Likert-scale questions, and two multiple response questions comprising a checklist of options and follow-up open-ended questions.

A survey design was selected for this study for several reasons. First, survey design provides a quantitative or numeric description of trends, perceptions, attitudes, or behaviors of a population sample (Creswell, 2009). Secondly, surveys can be administered to a large population rather than just individuals. Thirdly, the benefit of survey design data collection allows for rapid response and turnaround. Finally, survey collection was considered most feasible and economical with the least expense for the researcher. Data collection of this study was accomplished cross-sectionally at the end of one semester. Through a self-reported web-based survey questionnaire adapted from the CSEQ and SCEQ, students assessed their levels of engagement factors within their experience of the SI course and gateway mathematics course.

Setting

This study was conducted at a CSU that is located in Los Angeles County of Southern California. This study focused on students enrolled in supplemental courses that are attached to gateway mathematics courses. The selected gateway courses were mathematics 100-level courses. The typical enrollment in each gateway lecture course is 100-200 students, whereas the maximum standard enrollment in each section of SI course is 20-30 students. Although the study location was CSU, participants were given the option to complete the electronic survey at their convenience in SI class, at the LAC, or at other campus locations with accessible electronic devices including computers, tablets, and cell phones.

Population, Sample, Sampling Procedures

Target population. The researcher recruited prospective participants that were mathematics students enrolled in SI courses while concurrently enrolled in gateway mathematics courses at CSU. The average size of SI mathematics classes is 20-30 students; therefore, the researcher focused on at least seven SI classes that were attached to gateway mathematics 100-level courses, which yielded approximately 120-210 students to invite to participate in the study. The known general demographics of the prospective participants included males and females, diversity in cultural backgrounds, diverse academic levels, various academic majors in STEM and non-STEM Fields, an average age range of 18-25 years old for traditional students, and non-traditional students with an average age over 25 years old. To ensure equity in participation, the invitations involved the most standard inclusion criteria, which encompassed all students enrolled in a gateway mathematics course.

Sample size. To determine the sample size for a multiple regression model, the G*Power 3.1 software program (Faul, Erdfelder, Buchner, & Lang, 2009) was used. With five predictors (course and each of the four SCEQ factors) based on a large effect size range ($f^2 = 0.35$), an alpha level of $\alpha = .05$, the sample size to achieve sufficient power .80 the researcher determined that 43 respondents was sufficient for the study; therefore, the researcher targeted up to 45 respondents.

Sampling procedures. The researcher utilized non-probabilistic sampling procedures, which included convenience sampling and purposeful sampling. A convenience sample can be defined as a sample in which participants are selected on their ease of availability through the SI program (Lunenburg & Irby, 2008; Saumure & Given, 2012). Subjects were recruited through enrollment in SI math courses; the researcher provided an invitation letter to the SI coordinators to distribute invitations via email to the prospective students. Also, the researcher provided invitation flyers to the SI coordinators who gave them to the SI leaders to distribute to the students during the SI sessions. Based on the purposive sampling method utilized by the researcher, four SI course sections were selected for student participation: Math 113-Pre-Calculus (two SI sections), Math 115-Business Calculus (one SI section), and Math 122-Calculus (one SI section). Each of these courses is considered a gateway mathematics course based on students' required degree pathway of field of study (Chen & Soldner, 2013). Also, these courses were selected in order for the researcher to broaden the opportunity to obtain participants that represent a variety of majors from STEM and non-STEM fields. As reported by the SI program coordinator, students were enrolled in each SI course within academic learning communities; therefore, assignment of SI courses was connected to the students' declared field of study. As reported by the SI program coordinator, two Math 113 SI courses were offered for the Fall 2017 term and several Math 115 (Business Calculus) and Math 122 (Calculus) SI courses were offered for the term. Math 115 and Math 122 are considered equivalent in course curriculum; the significant difference is that Math 115 emphasizes problem solving strategies related to business and economics content and Math 122 is geared toward STEM majors and other non-STEM majors.

Participants were compensated for their participation with a $5 Starbucks card; upon completion of the survey, they presented the confirmation completion message to the researcher to receive the gift card. Several research studies have found that incentives such as vouchers and lotteries can increase response rates and response times (Deutskens, Ruyter, Wetzels, & Oosterveld, 2004).

The anticipated response rate was 30% of the invited participants; however, approximately 84% of the initial participant pool of 93 students in the four courses volunteered to participate in the study. The other students that did not participate were absent during the dates of data collection. Researchers have reported that short web-based surveys with an anticipated completion time of 15-30 minutes yield an average response rate of 25% (Deutskens et al., 2004). Similarly, Cook, Heath, and Thompson (2000) reported an average of 25-30% response rate from faculty and students to email surveys.

If there had been a case of low response rate to participants, then the researcher planned to distribute a follow-up invitation email to the SI coordinators to send to prospective participants with a reminder message to participate in the survey. Research shows that at least one email reminder within 5-7 days tends to increase participants' response rates, and in some cases, it double the rate (Deutskens et al., 2004; Sánchez-Fernández, Muñoz-Leiva, & Montoro-Ríos, 2012). However, since the researcher obtained more than the minimal desired sample size for participation, then there was no need to solicit more SI students.

Human Subjects Considerations

Before the commencement of data collection, the researcher obtained approval from the Pepperdine University Institutional Review Board (IRB). Also, the researcher obtained site permission from the coordinator of the SI programs and the office of the CSU IRB. Data collection commenced after all approvals were received.

The researcher informed the participants that their participation in this research study was strictly voluntary and they could opt to discontinue participation in the study at any time without risk of consequences. Given that the prospective participants in this study were adults, over the age of 18, then the only consent needed was the completion of a volunteer consent form to participate in the surveys. Since the data were collected from the web-based survey via online Qualtrics portal, the participants were directed to a landing page that presented the consent information; the participants were able to click “Accept” to indicate consent to proceed with the survey or “Cancel” to be redirected to a thank you page. In addition, the Qualtrics software was set to refrain from automatically gathering the respondents’ IP addresses; prospective participants were informed that any identifiers on the research study questionnaire would be kept confidential. Furthermore, if the findings of the study are presented to professional audiences or published, then no information that identifies any of the participants personally will be released. Minimal potential risks to the participants included discomfort due to the time necessary to complete the survey; therefore, providing the prospective participants with the option to withdraw or not participate mitigated any potential risks of embarrassment or discomfort. Although there were no potential benefits to participants, the contribution of their responses will help with future amendments to policy and practice of the SI and mathematics programs at the institution.

Measures

After conducting an extensive review of the literature about student engagement and inspection of survey instruments developed in previous studies, the researcher chose to adapt two previously developed versions of questionnaires on quality of effort of a student’s college experience and academic course engagement levels. Selection of both of these measurements helped the researcher by using the CSEQ to gain a snapshot of student significant background information and using the SCEQ take a snapshot of student engagement factors during a single semester or term.

The CSEQ was developed and first published in 1979 by Pace. The content of the CSEQ questionnaire was designed to provide additional information about the significance of quality of effort in the evaluation of higher education. “The main focus of the CSEQ questionnaire is on what students do in college, and on what conditions in college influence what they do and what they achieve” (Pace, 1984, p. 16). Consent to use the CSEQ instruments was obtained through email communication and completion of an Item Usage Agreement by the researcher and Robert Gonyea, Associate Director of the Center for Research at Indiana University (See Appendix B).

The SCEQ was developed to assess academic engagement levels of a specific course (Handelsman et al., 2005). The SCEQ was selected because the questions appropriately relate to the measurement of the research questions in this study. Consent to use the SCEQ questionnaire was obtained through email communication with one of the designers of the instrument, Mitchell Handelsman, Professor of Psychology at the University of Colorado at Denver (See Appendix C). The engagement scales used in the survey instrument of this study were borrowed from the SCEQ. To reduce measurement error, the survey instrument used in this study was a slightly modified version of the CSEQ and SCEQ instruments (See Appendix D).

The initial SCEQ was based on 27 behaviors and attitudes related to engagement. To test the structure factor of the SCEQ, an exploratory factor analysis was conducted, and reliability estimates were constructed. Although there was an initial development of seven factors, four factors were finalized on the SCEQ instrument. The four factors were delineated into subscales: skills engagement, emotional engagement, participant/interaction engagement, and performance engagement. On the skills engagement subscale, the coefficient alpha was 0.82. On the emotional engagement subscale, the coefficient alpha was 0.82. On the participation/interaction subscale the coefficient alpha was 0.79. On the performance engagement subscale, the coefficient alpha was 0.76. All coefficients were rated statistically significant at $p < 0.01$. (Handelsman et al., 2005). Based on the initial test and data analysis of the questionnaire, all engagement factors showed reasonable reliability with a range of 0.76 to 0.82, with the highest correlation of 0.44 between skills engagement and emotional engagement, which lends support to the discriminant validity and internal consistency of the SCEQ instrument. Finally, Handelsman, et al. (2005) performed several regression analyses between the course grades and the four engagement factors to determine any significant predictors and explain the percentage of variance of the engagement factors.

Instrumentation

The survey instrument of this research study consisted of the following three sections:

Demographic factors. The first section of this research study survey contained 13 questions labeled a-m, which included questions from the CSEQ questionnaire consisting of a series of items under the heading "Background Information." These items enabled the researcher to determine the relationship between the student engagement factors and important personal characteristics and various conditions in college (i.e., age, major field grades, etc.; Pace, 1984)

Engagement factors. The second section of the survey consisted of 23 questions relating to the four engagement factors. In this section, the participants were asked to indicate to what extent their behaviors, thoughts, and feelings described them in the course. These attitudes and behaviors were rated on a 5-point scale, with 5 indicating *very characteristic of me* and 1 indicating *not at all characteristic of me*. The scoring process for each subscale involved a total calculation of all responses within the subscale. The total engagement summed score for all four factors ranged from 23-115. The first factor, skills engagement, consisted of survey items 4, 5, 9, 10, 13, 14, 17, 20, and 23. The total summed score range for the skills engagement subscale was

9-45. The second factor, emotional engagement, consisted of survey items 7, 8, 11, 21, and 22. The total summed score range for the emotional engagement factor was 5-25. The third factor, participation/interaction, consisted of survey items 1, 2, 3, 6,18, and 19. The total summed score range for the participation/interaction engagement subscale was 6-30. The fourth factor, performance engagement consisted of survey items 12, 15, and 16. The total summed score range for the performance engagement factor was 3-15 (See Appendix D).

SI experience and other engagement opportunities. The third section of this research study survey consisted of item #24, which asked for the number of times the participant attended the SI sessions during the semester. Research studies have shown that SI students who have attended regularly (an average of 10 or more sessions throughout the semester) have statistically earned higher grades of half a letter to a full letter grade higher than those students who did not attend regularly (Martin & Arendale, 1992; Rath et al., 2012; Blanc et al., 1983). The researcher analyzed this information for patterns in grades.

Also, two multiple-response questions items, #25 and #26, asked the participants about their engagement experiences in the SI course and outside resources, if any, during their term of the mathematics course (See Appendix D). These responses were analyzed via SPSS software, yielding percentages of participants that endorsed each of the responses listed in the survey questions.

To ensure content validity and construct validity, minimize the level of discomfort to participants, and provide ample time to complete the survey, the researcher conducted a pilot study with several expert reviewers including a SI coordinator, an SI leader, and a previous SI student.

Data Collection Procedures

Subjects were recruited through the LAC at CSU, which facilitates the SI courses. The researcher sent an invitation letter to the SI coordinator who oversees program operations, asking them to distribute invitations via email to the prospective students. Although there are known general demographics of the prospective participants, invitations involved the most standard inclusion criteria, which encompassed all students enrolled in the gateway mathematics courses.

The research study survey was distributed electronically to the prospective participants via Qualtrics survey through a generated link and a QR code. The participants convened individually at their convenience within the established time frame to complete the survey online. Participants were given the option to complete the survey at their convenience in SI class, the LAC, or other campus locations with accessible electronic devices including computers, tablets, and cell phones.

On the initial page of the survey, the researcher provided a description of the purpose of the study, the risks and benefits of the study, the procedures of the study, and instructions for completing the survey. Also, at that time, participants were given the option to complete the volunteer consent information on the screen or choose to decline participation in the study. After each participant completed the survey, the screen prompted the participant with specific instructions to select a button for acceptance of his or her submission of the survey. Finally, the responses were electronically transmitted immediately to the Qualtrics program for the researcher to conduct the data analysis process. Data collection occurred at the end of the Fall 2017 term over a 6-week period from Monday, December 4, 2017, to Monday, January 30, 2018.

Since data collection occurred during one scheduled time frame and the minimum sample size was obtained, then no follow-up contact was needed.

Data Management

All secured data including digital hard copies and researcher will be kept in a locked file cabinet at the researcher's residence, to which only the researcher will have access, in order to ensure confidentiality and security. Throughout data analysis, all digital data and information that was maintained on any Microsoft Office software was stored on a password-protected computer, to which only the researcher has password access. The data will be kept for a minimum of 5 years by the researcher, and then all data will be destroyed.

Quantitative Analytic Techniques

It was hypothesized that a relationship exists between student engagement and course grades among students enrolled in a SI mathematics course while concurrently enrolled in a gateway mathematics course. Student engagement and course grades were identified as outcome variables, and enrollment status, bifurcated as student enrollment in an SI course and gateway mathematics course, were considered the predictor variables. The research study survey was used to measure the outcome variable of student engagement, whereas grades were measured by grading scale reports of 0.00-4.0 with the assignment of letter grades F-A. Student engagement was measured at the interval level, grades were measured at the nominal level, and enrollment status was measured at the nominal dichotomous level.

Survey data were collected via responses submitted by participants via a web-based survey generated by Qualtrics software. Participants were encouraged to answer all questions but were not required to do so. The data were organized via Microsoft Excel spreadsheet, cleaned, and compatibly formatted for export to SPSS for further analysis. The researcher utilized a second expert reviewer to verify the accuracy of the data.

Univariate normality was tested using boxplots. Multivariate normality was tested using the Mahalanobis distance statistic. The potential of multicollinearity was assessed through a correlation matrix as well as the VIF and tolerance statistics. Statistical independence was assessed using the Durbin-Watson statistic. The presence of homoscedasticity was examined using a scatterplot of the standardized residuals plotted against the unstandardized predicted values.

Initially, descriptive statistics were calculated. For continuous variables, means and standard deviation were used. For categorical variables, frequencies and percentages were used. Inferential statistics were used to verify if there were statistically significant relationships between the variables. The alpha level for this study was set at $p < .05$. For research question one, a Pearson correlation was conducted. For research question two, a multiple regression statistical test was constructed. To determine the sample size for a multiple regression model, the G*Power 3.1 software program (Faul et al., 2009) was used. With five predictors (course and each of the four SCEQ factors) based on a large effect size range ($f^2 = 0.35$), an alpha level of $\alpha = .05$, the sample size to achieve sufficient power .80 the researcher determined that 43 respondents were sufficient for the study; therefore, the researcher targeted up to 45 respondents.

Textual Analysis Procedure

For those participants who responded to the open-ended questions of survey items 25-26, sample illustrative quotations were selected. These items were analyzed as follows: the researcher deductively classified the text responses into a table with labeled categories that represent the four engagement factor subscales, then the table was analyzed for frequencies of engagement factors.

Positionality

The researcher in this study possesses a Bachelor of Arts Degree in Mathematics and a professional clear single subject credential authorized to teach ages pre-K to adult mathematics. Also, the researcher has more than 25 years of experience teaching a variety of mathematics courses to students of different academic levels and diverse demographics. Within the past 5 years, the researcher has taught gateway mathematics at the postsecondary level including at private colleges and CSU. At CSU, the researcher has facilitated several SI courses attached to gateway mathematics courses, so she has previous insights on the implementation of the SI model and has monitored the progress of student grades. During this study, the researcher was not employed with CSU, which did not pose any conflicts or issues of coercion of enrolled students in the SI classes. With this experience, during this study, the researcher intentionally set aside biases and assumptions, constantly sought out feedback from various perspectives such as the dissertation chair, the dissertation committee, and expert reviewers. Also, the researcher was mindful to conduct objective data analysis with the support of an external expert statistician to ensure reliability and credibility in descriptions of data results.

Chapter 4: Findings

The purpose of this quantitative correlational survey study, conducted at CSU, was to investigate engagement factors employed by SI students enrolled in gateway mathematics courses. In addition, the researcher explored the relationships, if any, of the SI students' engagement factors to their gateway mathematics course grades. This study intended to answer the following research questions to gain a better understanding of the effects of student engagement factors on course grades of students enrolled in a gateway mathematics course. The researcher explored the following research questions with SI students at CSU.

1. To what extent, if at all, are any of the SI students' academic course engagement factors individually related to their gateway mathematics course grades?
2. To what extent, if at all, is the linear combination of the SI students' four academic course engagement factors related to their gateway mathematics course grades?

To accomplish this purpose, a web-based survey of student engagement was administered to 78 students enrolled in SI courses that were attached to gateway mathematics courses during the Fall 2017 term of the school year. This chapter presents the findings of this study; it is organized by participant background information, research question one, research question two, additional findings, and a summary of key findings.

Findings

Participant background information. The 13 initial items from the survey asked the participants to respond to prompts regarding general demographics, enrollment status, and self-reports of grades earned in the gateway mathematics course. Table 1 displays the frequency counts for selected variables of demographics. A total of 78 students enrolled in a mathematics SI course participated in this study. As displayed in the table, more females (56.4%) were enrolled in the SI classes than males (43.6%). In addition, the greatest number of participants identified with the Hispanic/Latina(o) ethnic group, 42 (53.8%), followed by 25 participants selecting Asian or Pacific Islander (32.1%). Although the age range of participants was 18-28, 71 participants reported an age between 18-19 (91%).

Table 1

Frequency Counts for Participant Background Information (N = 78)

Variable	Category	*n*	%
Gender	Male	34	43.6
	Female	44	56.4
Race/Ethnicity	Asian or Pacific Islander	25	32.1
	Black or African American	2	2.6
	Caucasian (Other than Hispanic)	6	7.7
	Hispanic/ Latina(o)	42	53.8
	Other	3	3.8
Age [a]	18	59	75.6
	19	12	15.4
	20 to 28	7	9.0

[a] Age: M = 18.60, SD = 1.65.

Table 2 illustrates the reports of participants on enrollment classification, and whether they initially enrolled at CSU or transferred from other institutions. Most students classified enrollment status as freshman/first year (85.9%) and at least one student reported classification of senior/5th-year (1.3%). Almost all of the participants commenced their enrollment in studies at CSU (94.9%), whereas four students transferred to CSU from a community college (5.1%).

Table 2

Classification in College and Fields of Study, Initial or Transfer Student

Variable	Category	*n*	%
Classification in College			
	Freshman/first year	67	85.9
	Sophomore/2nd year	5	6.4
	Junior/3rd year	5	6.4
	Senior/5th year	1	1.3
Initial or Transfer Student			
	Started at CSU	74	94.9
	Transferred from a community college	4	5.1

Table 3 displays the report of frequency counts of programs of major fields of study. The most common major reported by participants was biological studies (44.9%), followed by business (25.6%) and engineering (24.4%). A small percentage of other major fields of studies was represented, including education (2.6%) and health related fields (2.6%). The data show that participants reported enrollment in more STEM majors (82.2%) than non-STEM majors.

Table 4 illustrates the number of participants that participated in this study from each selected SI class, the frequency of number of credits that students enrolled for the Fall 2017 term, and the frequency of overall GPA of each student. The data in Table 4 show that more students were enrolled in Math 115 and 122 (53.8%) than in Math 113 (46.2%). This shows that there were more students enrolled in Calculus SI courses than Pre-Calculus SI courses. Although all participants were enrolled in at least 12 course credits for the term, the largest number of participants reported 15-16 course credits (59.0%). The range of overall GPAs at CSU was 0.00-3.50, but, since most participants reported freshman status (85.9%; Table 2), then the largest number of participants had earned overall GPAs of 0.00 (74.2%).

Table 3

Frequency Counts of Major Fields of Study Sorted by Highest Percentage (N=78)

Category	***n***	%
Biological/Life Sciences	35	44.9
Business	20	25.6
Engineering	19	24.4
Computer and Information Systems	5	6.4
Pre-Professional	3	3.9
Health Related Fields	2	2.6
Education	2	2.6
Other	1	1.3

Note. Percentages total more than 100% due to multiple responses.

Table 4

Frequency Counts of Math Course Assignment, Number of Credits for Fall, 2017 Term, Overall Grade Point Average (N = 78)

Variable	Category	*n*	%
Math Course	Math 113	36	46.2
	Math 115	19	24.4
	Math 122	23	29.4
Number of Course Credits this term	12-14	29	37.2
	15-16	46	59.0
	17 or more	3	3.8
	(*n* = 66) [a]		
Overall Grade Point Average at CSU	0.00	49	74.2
	1.50-1.70	3	4.5
	2.00-2.99	4	6.1
	3.00-3.50	10	15.2

[a] A GPA of 0.00 means that they were in their first semester and not that they failed all courses.

Table 5 displays the frequency count of self-report responses of the participants' midterm exam grade and overall current grade in the attached gateway mathematics course to the SI course. Seventy-five participants earned a C or better grade on the midterm exam (96.2%) and 73 participants reported an overall current grade of C or better (93.6%) in the gateway mathematics course.

Table 5

Frequency Counts of Self-Report Responses of Midterm Exam grade and Overall Current Grade (N = 78)

Variable	Category	*n*	%
Midterm Exam Grade	A	32	41.0
	B	30	38.5
	C	13	16.7
	D	2	2.6
	F	1	1.3
Overall Current Grade	A	15	19.2
	B	41	52.6
	C	17	21.8
	D	5	6.4
	F	0	0.0

Table 6 illustrates the frequency counts of weekly math study hours outside of the mathematics class and the SI class, the frequency of utilization of the learning center to improve math skills, and the total number of SI sessions each participant attended throughout the Fall 2017 term. Over half of the participants spent 5 or fewer weekly hours on math studies outside of the math class and SI sessions (57.7%). The largest number of participants occasionally used a campus lab or a learning center to improve their math skills (51.3%). Although the range of number of sessions attended was 15-30, most students attended 25-30 sessions (80.8%; M = 26.86, SD = 4.19).

Table 6

Frequency Counts of outside Weekly Study Hours, Use of Learning Center, SI Sessions Attended (N = 78)

Variable	Category	*n*	%
Outside weekly math study hours	5 or fewer hours	45	57.7
	6-10 hours	24	30.8
	11-15 hours	7	9.0
	15 or more hours	2	2.6
Use of campus learning lab or center	Never	23	29.5
	Occasionally	40	51.3
	Often	10	12.8
	Very Often	5	6.4
SI Sessions attended during semester [a]	15-24	15	19.2
	25-29	31	39.8
	30	32	41.0

[a] Sessions: M = 26.86, SD = 4.19.

Table 7 displays the total number of items from the multiple response prompt that participants participated during the SI Sessions. The table shows the frequency of items as categorized into the four engagement factors. As described in the literature section of this study, the engagement factors include: skills engagement, participation/interaction engagement, emotional engagement, and performance engagement. Most of the participants selected a range of 8-12 items of activities that they participated in during the SI sessions throughout the term (M = 8.91, SD = 8.82). Most students worked out practice problems within the skills engagement factor (89.7%). Within the participation/interaction factor, most students worked actively with partners and/or small groups (89.7%). Within the emotional engagement factor, most students felt comfortable working in groups (84.6%) which is only slightly higher than the students who felt comfortable asking questions (82.1%) during the SI sessions. Within the performance engagement factor, most students studied for exams (80.8%).

Table 7

Frequency Counts for Total Items Participated in SI and Counts of Specific Items Related to Each Engagement Factor in SI Sessions (Aligned to Engagement Factors)

Variable	Category	*n*	*%*
Total items of participation in SI [a]	1-7	20	25.6
	8-10	32	41.0
	11-12	26	33.4
Skills Engagement	Worked out practice problems	70	89.7
	Reviewed lecture notes	67	85.9
	Learned helpful study strategies	50	64.1
Participation/Interaction Engagement	Actively worked with partners and/or small groups	70	89.7
	Helped other students	61	78.2
	Met with SI leader for help	41	52.6
Emotional Engagement	Felt comfortable working in groups	66	84.6
	Felt comfortable asking questions	64	82.1
	Felt comfortable answering questions	57	73.1
Performance Engagement	Studied for exams	63	80.8
	Reflect on and/or self-correct math class exams	45	57.7
	Completed practice quizzes	41	52.6

[a] Participation: $M = 8.91$, $SD = 8.82$.

Table 8 displays the results of the activities in which the participants reported participating during the SI sessions. The different frequency results reflect the options of participants to select several responses from the multiple checklist provided in the survey. An equal number of participants selected the most common represented activities as actively participating with partners and/or small groups (89.7%) and working out practice problems (89.7%), followed by reviewing lecture notes (85.9%). The least two activities selected by the participants were met with SI instructor (52.6%) and completed practice quizzes (52.6%).

Table 8

Frequency Counts of Activities Participated in SI Sorted by Highest Percentage

Category	*n*	%
Actively worked with partners	70	89.7
Worked out practice problems	70	89.7
Reviewed lecture notes	67	85.9
Felt comfortable working in groups	66	84.6
Felt comfortable asking questions	64	82.1
Studied for exams	63	80.8
Helped other students	61	78.2
Felt Comfortable answering questions	57	73.1
Learned helpful study strategies	50	64.1
Reflected on math class exams	45	57.7
Met with SI leader for extra help	41	52.6
Completed practice quizzes	41	52.6

Note. Percentages total more than 100% due to multiple responses.

Table 9 illustrates the items selected by the participants as additional resources used outside of the math class activities and the SI class sessions. The most common selected resource was Google search (69.2%) followed by YouTube videos (65.4%). The least selected resource was private tutoring (14.1%).

Table 9

Frequency Counts of Additional Resources Sorted by Highest Percentage

Category	*n*	%
Google Search	54	69.2
YouTube Videos	51	65.4
Attended study groups with friends	46	59.0
Used phone or online apps	42	53.9
Went to learning center	36	46.2
Online Study Website	28	35.9
Asked family members	15	19.2
Private Tutoring	11	14.1

Note. Percentages total more than 100% due to multiple responses.

Table 10 displays the psychometric characteristics of the five summated engagement factor scale scores. These ratings were based on a 5-point metric: 1 = *not at all characteristic of me* to 5 = *very characteristic of me.* Performance engagement showed the highest summed score for most characteristic of the students (*M* = 4.11 and *SD* = 8.37). Although the emotional engagement scale represented moderate characteristic of the students, the scale showed the lowest summed score (*M* = 3.26, *SD* = 0.77). All scales demonstrated acceptable levels of internal reliability, with Cronbach alpha scores ranging from α = .70 to α = .87, which are at or above the minimum standard level of 0.70 (Creswell, 2009). The highest alpha level was performance engagement, α = .87, and the lowest alpha level was participation/interaction engagement, α = .70. In addition to the total engagement scale, all of the engagement factor scales showed that participants felt each scale at least moderately represented their characteristics of engagement in the gateway mathematics course.

Table 10

Reliability Scales for Four Engagement Factors

Category	Number of Items	Low	High	*M*	*SD*	α
Total Engagement	23	1.96	4.70	3.66	0.62	.90
Skills Engagement	9	1.44	5.00	3.97	0.66	.84
Emotional Engagement	5	1.00	5.00	3.29	0.96	.86
Participation/Interaction	6	1.67	4.83	3.26	0.77	.70
Performance Engagement	3	2.00	5.00	4.11	0.84	.87

Note. Ratings based on a five-point metric: 1 = *not at all characteristic of me* to 5 = *very characteristic of me.*

Table 11 represents the frequency counts and percentage of codes of textual responses to the open-ended prompts. These codes reflect the association of the actual comment to the 4 engagement factors. The highest number of codes of participant comments were related to participation/interaction engagement (47.1%). The lowest number of codes of participant comments were related to emotional engagement (7.9%).

Table 11

Frequency Counts of Textual Codes Related to Engagement Factors Sorted by Highest Percentage (N = 140)

Variable	*n*	%
Participation/Interaction Engagement	66	47.1
Skills Engagement	44	31.4
Performance Engagement	19	13.6
Emotional Engagement	11	7.9

Note. Percentages total more than 100% due to multiple responses. Frequency counts based on codes created from analysis of comments by participants.

Comments from open-ended prompt 25b. Several participants added responses that reflected their selection of the top two or three activities that were most helpful to learn the math content. The researcher coded the following quotes within the constructs of the four engagement factors. From the 66 textual codes related to participation/interaction engagement, several participants shared comments and reflections. A participant shared, “We did fun Jeopardy games and activities.” Another participant remarked, “Working in small groups in class was great because we would all get together to solve practice problems and when someone wouldn’t understand a concept they could get help from another person within the group and vice versa.” Another participant shared, “I believe working with other people helped me get a different look at problems and working out practice problems helped me better prepare.”

Several participants input comments related to the interaction component of engagement which involved interaction with the SI leader. A participant shared,

> Meeting with the SI leader helped me get one on one help because sometimes I felt like everyone around me thought the material was easy and that I was the only one struggling. So, it was nice to focus on teaching tailored to my needs.” Likewise, another participant

> expressed, “I really benefited from the SI instructor’s office hours and willingness to answer my questions in person and via email.

Additionally, a participant shared, “Meeting up with [my SI leader] for office hours helps a lot, his office hours are a lot more flexible than the professor’s office hours.”

Of the 44 codes of textual comments related to skills engagement, many participants added reflections associated to this factor. A participant shared, “If it wasn’t for this class I wouldn’t have studied.” Another participant shared,

> What helped me most was asking questions in SI since it was more of a comfortable environment to do so considering the class was small and the second thing was going over lecture notes again in SÍ since sometimes I don’t understand the notes even though I wrote it down.

From the 11 codes of textual comments by the participants for emotional engagement, several of them made additional statements. A participant stated, “In a small class setting you feel a lot more comfortable asking your classmates and the leader questions.” Another participant asserted, “The activities that helped me learn the most was being comfortable in the class to ask questions.” From the 19 codes of textual comments by the participants about performance engagement, several participants added several comments. A participant imparted, “Study guides and practice quizzes have really helped prepare for the exams.” Another student agreed, “Having study sessions right before an exam was really helpful.”

Table 12 illustrates the frequency counts and percentages of textual codes of participant comments associated with additional resources used outside of the math class activities and the SI sessions. The highest number of textual codes of participants’ comments was attending study groups with friends (22.3%), followed by YouTube videos (20.7%). The lowest number of textual codes of participants’ comments were using phone or online apps (3.3%) and asking family members for help (3.3%).

Table 12

Frequency Counts of Textual Codes of Additional Resources Used Outside of Math Class and SI Class Sorted by Highest Percentage (N = 121)

Category	*n*	%
Attended study groups with friends	27	22.3
YouTube Videos	25	20.7
Online Study Website	17	14.0
Other-peer mentors, independent study, etc.	14	11.6
Went to learning center	13	10.7
Google Search	8	6.6
Private Tutoring	8	6.6
Used phone or online apps	4	3.3
Asked family members	4	3.3

Note. Percentages total more than 100% due to multiple responses. Frequency counts based on codes created from analysis of comments by participants.

Comments from open-ended prompt 26b. In question 26b, Participants were asked to comment on two or three of the selected activities that most helped them learn the math content and add additional resources not listed. Participants utilized a variety of additional resources outside of attending SI sessions and the math class. A participant shared, “Going to the learning center almost every day helped me with completing all assignments with an A and taught me more about my mistakes and how to revise them.” Another participant expressed, “Being able to do my homework and assignments with tutors on standby was great.”

Examples of the learning centers reported in the comments included the Learning Assistance Center (LAC), the science and mathematics center, and the engineering success center. The LAC is home base for the SI programs, SI program coordinators, and students who meet the SI leaders for one-on-one tutorial sessions. Since 19 of the participants reported their major field as engineering (Table 3), then some of the tutoring sessions took place in the engineering learning center.

Participants who attended small study groups with friends added in comments that they met with peer mentors at CSU. One participant shared, “Being able to work with other students has helped me to realize my mistakes and let me teach others as well to help myself better understand the concepts.” Another participant mentioned, “Teaching others how to do the problems really helps because you can attack math problems from different angles.” Likewise, another participant expressed, “Getting help from family really helps because they have experience.” Although most participants preferred working in small groups, an outlier quote from one of the participants read,

> More than anything, I learned the most when diligently working on my own. Although I took advantage of my resources, the main progress I experienced was done independently and on my own efforts. That’s in my opinion something to be proud of.

More than five students mentioned using the resources of Khan Academy, which offers YouTube videos and a dedicated website for additional resources.

Twenty-five participants added comments about YouTube videos as the one of the top resources that helped them learn the math content in their class. One participant stated, “The thing that helped me out the most was YouTube videos since the ones I watched were very simple, clear and concise which were best to get the topic of this type of math across to me.” Similarly, another participant voiced, “YouTube videos helped me a lot with practice problems and having a strong visual.” Another participant expressed, “YouTube helped me see how it was done and online websites helped me check my answers.”

Some apps that participants added to their comments included Symbolab and Chegg. Examples of websites included Desmos.com, WebAssign, Chegg, and Symbolab which are both websites and apps. Symbolab is an answer engine developed by EqsQuest Ltd. This online service computes step-by-step solutions to mathematical problems in a range of subjects. A participant responded that "Using apps to help with graphs helped me visually learn." Another participant shared, "Using my phone helped me because I would use it as a calculator, to search up terms that were confusing, concepts I forgot about, and more." A participant commented, "Googling material I didn't quite understand 100% helped me solidify what we learned in my math course."

Table 13 displays the correlations of the engagement factors to the midterm exam grade and overall current grades of the participants of the gateway mathematics course. Inspection of the results showed significant positive correlations for seven out of the eight Pearson correlations for the four engagement factor scales with the midterm exam grade and the overall current grades. The skills engagement factor scale regression to the midterm exam grade was almost significant (r = .22, p = .06). The performance engagement factor scale showed the highest positive correlation for both midterm exam grade (r = ,62, p = .001) and the overall current grade (r = ,78, p = .001) of the gateway mathematics course.

Table 13

Pearson Correlations of Engagement Factors to Overall Grade and Midterm Exam Grade

Variable	Overall Grade		Midterm Exam Grade	
Total Engagement	.53	****	.45	****
Skills Engagement	.35	***	.22	
Emotional Engagement	.36	****	.35	***
Participation/Interaction Engagement	.38	****	.40	****
Performance Engagement	.78	****	.62	****

**p <.05. ** p<.01. *** p<.005. **** p<.001*

Research question one. The researcher investigated research question one, "To what extent, if at all, are any of the SI students' academic course engagement factors individually related to their gateway mathematics course grades?" The researcher conducted Pearson correlation regressions on the student engagement factors to the midterm exam grade and the overall current grade of the gateway mathematics course. The related alternative hypothesis, Ha1, was that at least one of the four academic course engagement factors is related to the students' gateway mathematics course grades. The related null hypothesis was that none of the four academic course engagement factors are related to the students' gateway mathematics course grades. The alternative hypothesis was addressed using a Pearson correlation (see Table 13). Inspection of the table shows seven out of eight significant positive correlations between the four individual engagement factors with the midterm exam grade and overall current grades in the gateway mathematics course. These findings led the researcher to reject the null hypothesis and provide support for the alternative hypothesis (Table 13).

Research question two. The researcher investigated research question two, "To what extent, if at all, is the linear combination of the SI students' four academic course engagement factors related to their gateway mathematics course grades?" The related alternative hypothesis was, Ha2, The linear combination of the four course engagement factors is related to the students' gateway mathematics course grades. To answer this question, two multiple regression models were created: current course grade (Table 14) and midterm exam grade (Table 15).

For current course grade (Table 14), the overall four variable model was significant ($p = .001$) and accounted for 60.8% of the variance in the current course grade. Inspection of the beta weights found that the current course grade was positively related to performance engagement ($\beta = .78$, $p = .001$).

Table 14

Multiple Regression Model Predicting Current Grade in Course Based on the Student Engagement Factors (N = 78)

Variable	*B*	*SE*	β	*t*	*p*
Intercept	-0.32	0.40		-0.80	.43
Skills Engagement	0.06	0.11	.05	0.51	.61
Emotional Engagement	0.04	0.08	.05	0.48	.64
Participation Engagement	-0.09	0.10	-.09	-0.93	.35
Performance Engagement	0.76	0.09	.78	8.78	.001

Note. Full Model: F (4, 73) = 28.33, p = .001. R^2 = .608.

For the midterm exam grade (Table 15), the overall four variable model was significant (p = .001) and accounted for 40.7% of the variance in the midterm exam grade. Inspection of the beta weights found that the midterm exam grade was positively related to performance engagement (β = .57, p = .001). This combination of findings provided support to accepting alternative hypothesis two.

Table 15

Multiple Regression Model Predicting Midterm Exam Grade in Course Based on the Student Engagement Factors (N = 78)

Variable	*B*	*SE*	β	*t*	*p*
Intercept	0.66	0.54		1.22	.23
Skills Engagement	-0.18	0.15	-.13	-1.17	.25
Emotional Engagement	0.13	0.11	.14	1.17	.24
Participation Engagement	0.09	0.13	.08	0.70	.48
Performance Engagement	0.60	0.12	.57	5.21	.001

Note. Full Model: F (4, 73) = 12.51, p = .001. R^2 = .407.

Additional Findings

The additional analyses in Table 16 illustrate the frequency counts of combinations of grades earned by each participant from the midterm exam grade to overall current grade in the gateway mathematics course. In addition, the lowest and highest summed scores (illustrated as a range) of each engagement factor and total engagement were aligned with the grade combinations. Most participants who earned an A for midterm exam grade and an A or B (35.9 %) for the overall current grade scored a total engagement range of 53 (low) to 107 (high), and the performance engagement summed scores ranged from 12 to 15. In addition, several participants who earned the same grade of B for both midterm exam grade and the overall current grade (30.8%) scored total engagement with ranges from 66 (low) to 104 (high), and the performance engagement summed scores ranged from 8 to 15. The participants that earned a midterm exam grade of C, D, or F and an overall current grade of C or D scored a total engagement range of 45 (low) to 86 (high; 15.4%), and the performance engagement summed scores ranged from 6 (low) to 14 (high).

Table 16

Frequency Counts of Summed Score Ranges for Each Engagement Factor, Total Summed Engagement Score, Midterm Exam Grade and Overall Current Grade Sorted by Highest Letter Grade (N = 78)

Skills	Participation	Emotional	Performance Engagement	Total Engagement Score	Midterm Exam Grade	Overall Current Grade	*n*	%
29-45	15-27	11-25	13-15	80-107	A	A	15	19.2
13-44	11-28	7-25	12-15	53-107	A	B	13	16.7
27-40	14-27	10-23	9-13	70-103	A	C	4	5.1
26-43	12-27	10-23	8-15	66-104	B	B	24	30.8
31-44	18-29	12-23	8-12	74-108	B	C	5	6.4
34	19	16	9	63	B	D	1	1.3
33-40	15-26	10-21	11-14	76-101	C	B	4	5.1
21-37	10-20	5-17	6-10	45-80	C	C	7	8.9
31-34	14-15	11-13	8-10	59-67	C	D	2	2.6
41	16	15	14	86	D	C	1	1.3
37	14	16	6	73	D	D	1	1.3
29	15	7	7	61	F	D	1	1.3

Note. Total possible scores: Skills Score Range low 9 to high 45; Participation Score low 6 to high 30; Emotional Score Range low 5 to high 25; Performance Score Range low 3 to high 15. Total Engagement Score Range Low 23 to High 115.

Further analysis included two stepwise multiple regression models: current course grade (Table 17) and midterm exam grade (Table 18). These models used 45 candidate variables (15 potential majors, 12 activities, eight resources, and 10 demographic variables). For current course grade (Table 17), the final four variable model was significant (p = .001) and accounted for 68.3% of the variance in the current course grade. Inspection of the beta weights found the current course grade was positively related to: (a) performance engagement (β = .85, p = .001), (b) asking family members (β = .19, p = .006), (c) not working out practice problems (β = -.19, p = .007), and (d) attending more sessions (β = .15, p = .03).

Table 17

Stepwise Multiple Regression Model Predicting Current Grade in Course Based Selected Variables (N = 78)

Variable	*B*	*SE*	β	*t*	*p*
Intercept	-0.93	0.46		-2.01	.05
Performance Engagement	0.82	0.07	.85	12.43	.001
Asked family members	0.39	0.14	.19	2.84	.006
Worked out practice problems	-0.50	0.18	-.19	-2.77	.007
Sessions Attended	0.03	0.01	.15	2.26	.027

Note. Full model: F (4, 73) = 39.25, p = .001. R^2 = .683. Candidate variables = 45.

For midterm exam grade (Table 18), the final two variable model was significant (p = .001) and accounted for 46.6% of the variance in the midterm exam grade. Inspection of the beta weights found the midterm exam grade was positively related to: (a) performance engagement (β = .62, p = .001), and (b) not being a biological/life sciences major (β = -.28, p = .006).

Table 18

Stepwise Multiple Regression Model Predicting Midterm Grade in Course-Based Selected Variables (N = 78)

Variable	*B*	*SE*	β	*t*	*p*
Intercept	0.67	0.38		1.76	.08
Performance Engagement	0.66	0.09	.62	7.39	.001
Biological/Life Sciences	-0.50	0.15	-.28	-3.36	.001

Note. Full model: F (2, 75) = 32.67, p = .001. R^2 = .466. Candidate variables = 45.

Cohen (1988) suggested some guidelines for interpreting the strength of linear correlations. He suggested that a weak correlation typically had an absolute value of r = .10 (r^2 = 1% of the variance explained), a moderate correlation typically had an absolute value of r = .30 (r^2 = 9% of the variance explained) and a strong correlation typically had an absolute value of r = .50 (r^2 = 25% of the variance explained). Therefore, for the sake of parsimony, this results chapter primarily highlights those correlations that were of at least moderate strength to minimize the potential of numerous Type I errors stemming from interpreting and drawing conclusions based on potentially spurious correlations.

In addition, the 45 candidate variables (15 potential majors, 12 activities, eight resources, and 10 demographic variables) were correlated with current course grade and midterm exam grade. For the resulting 90 correlations, 10 were statistically significant at the $p < .05$ level and three were of at least moderate strength using the Cohen (1988) criteria. Specifically, helping other students was positively related to both the current course grade ($r = .36$, $p = .001$) and the midterm exam grade ($r = .34$, $p = .002$). In addition, students who felt comfortable asking questions had higher midterm exam grades ($r = .35$, $p = .002$).

Summary of Key Findings

In summary, this study reflected data from 78 SI students to examine the relationship between the four engagement factors to the gateway mathematics course grade. The background data of the participants represented a diversity in demographics in age, gender, and ethnic group, classification in college, initial or transfer students, major fields of study in STEM and Non-Stem fields. Overall, the positive correlations of the engagement factors to the gateway mathematics grade showed that students with higher levels of engagement generally earned a better grade.

There was support for the alternative hypothesis one (see Table 13), indicating a positive relationship of seven of the eight Pearson Correlations of the four engagement factors to the midterm exam grade and overall current grade in the mathematics course. Therefore, the researcher rejected null hypothesis one. Data yielded support for alternative hypothesis two (see Tables 14 and 15), indicating that the linear combination of the four engagement factors was related to both the midterm exam grade and overall current grade in the mathematics course. Therefore, the researcher rejected null hypothesis two.

In Chapter 5, these findings will be compared to the literature, conclusions and implications will be illuminated, and a series of recommendations for further research will be presented.

Chapter 5: Discussion, Recommendations, and Conclusions

Purpose of the Study

The purpose of this quantitative correlational survey study, conducted at CSU, was to investigate engagement factors employed by SI students enrolled in gateway mathematics courses. In addition, the researcher explored the relationships of the SI students' engagement factors to their gateway mathematics course grades.

Research Questions

This study was guided by the following two research questions:

1. To what extent, if at all, are any of the SI students' academic course engagement factors individually related to their gateway mathematics course grades?
2. To what extent, if at all, is the linear combination of the SI students' four academic course engagement factors related to their gateway mathematics course grades?

Research Design Overview

This study employed a quantitative correlational survey design which the researcher investigated the relationships between student engagement factors and the gateway mathematics course grades among college students enrolled in a SI course while concurrently enrolled in the attached gateway mathematics course. Seventy-eight SI students at CSU, a 4-year university, participated in the study. Participants completed a survey that consisted of 13 background questions, 23 engagement factor items, two multiple response questions on activities in which they participated during the SI session, and the use of additional resources outside of the SI sessions and the math class. The two multiple response questions contained follow-up open ended prompts that allowed participants to add comments to support their top two to three selections that helped them learn the mathematics course content. Related to research question one, it was hypothesized that at least one of the four academic course engagement factors would be related to the SI students' gateway mathematics course grades. Related to question two, it was hypothesized that the combination of the four course engagement factors would be related to the SI students' gateway mathematics course grades. This chapter discusses the key findings and the conclusions of the study, presents implications for policy and practice, describes recommendations for further study, and concludes with a summary.

Discussion of Key Findings

Participant background information. Seventy-eight SI students concurrently enrolled in a gateway mathematics course at CSU participated in this quantitative correlational study. The background data of the participants represented diversity in demographics in age, gender, ethnic group, classification in college, major fields of study in STEM, and non-Stem fields, gateway mathematics course grades, and SI attendance. There were more female participants (56.4%) than male participants (43.6%), and participants included a large number of Hispanic (53.8%) and Asian Pacific Islander participants (32.1%). The most common major fields of study were STEM fields (82.2%), which included biological sciences (44.9%), engineering (24.4%), computer science (6.4%) and health related fields (6.5%). There was a lower percentage of non-STEM majors (28.2%), which included business (25.6%) and education (2.6%). Since several previous studies reported that the highest attrition rates occur among bachelor's level students during their first 2 years of science courses, these findings of the common STEM fields of study confirm that there is a need to continue to provide academic support services including the SI program, especially to the high percentage of STEM students, to ensure success in the gateway mathematics courses to maintain persistence toward program completion (Arendale, 2000; Chen & Soldner, 2013; Cheng et al., 2008; Martin & Arendale, 1992). In addition, the high percentage of STEM majors reported by the participants (82.2%) concur with the reports by Chen and Soldner (2013) of the higher percentage of STEM students that are enrolled in gateway mathematics courses during the first 2 years of enrollment. In addition, the findings support the need to offer academic support programs for gateway mathematics courses to maintain or increase retention rates of students enrolled in these courses that are considered at-risk (Arendale, 2000; Chen & Soldner, 2013; Cheng et al., 2008; Martin & Arendale, 1992).

The majority of the students were classified as freshman/first year students (85.9%), which explains the data reported by participants who had earned a cumulative GPA of 0.00 (74.2%). In addition, most students earned a C or better in their gateway mathematics course for their midterm exam grade (96.2%) and their overall current grade (93.6%). The SI coordinator reported the withdrawal rate (5%) of the enrollment of SI participants from the four selected SI courses for this study. It is significant to point out that the withdrawal rate of 5% shows that most participants persisted to completion of the mathematics course toward the end of the term. The findings of these grades support previous research results showing that SI students earn lower percentages of DFW grades in the at-risk course (Arendale, 2000; Blanc et al., 1983; Martin & Arendale, 1992). Likewise, most students earned an A or B grade for their midterm exam grade (79.5%) and overall current grade (71.8%). which aligns with the reports of Budney et al. (1998) that a greater retention rate of students occurs with those who achieve higher grades in their first semester of their first year of enrollments. Similarly, these findings concur with the research results of Belcheir (2005), in that higher grades of A or B earned in the mathematics course may motivate SI participants to continue on with enrollment in subsequent semesters, particularly the Spring 2018 term for these CSU students. (The data was not available from CSU to confirm how many students actually enrolled for Spring, 2018)

Although the maximum number of SI sessions offered per gateway course during the term was 30 sessions, the data revealed a wide range of SI sessions attended by the participants (15-30); however, most participants reported that they attended 25-30 sessions (80.8%) during the Fall 2017 term. These findings concur with the outcomes of many past research studies, indicating that students who attend 10 or more SI sessions earn higher grades in the at-risk course (Arendale, 2000; Blanc et al., 1983; Martin & Arendale, 1992; Rath et al., 2012). However, since this research study did not include non-SI participants, then there was no data to affirm or contradict the variance in how much of a letter grade that the SI students earned more than the non-SI participants enrolled in the same gateway mathematics courses. Gupta et al. (2006) found that academic success in mathematics classes was linked to positive class attendance. Similarly, Svanum and Bigatti (2009) concluded that class attendance positively influenced course success which is evidence in the results of this study with the high percentage of overall current grades of C or better at the end of the term.

SI participation and additional resources. From the survey list of SI activities, most of the participants reported that they participated in 8-12 activities during the SI sessions throughout the term (74.4%). Most students worked out practice problems within the skills engagement factor (89.7%) which Martin & Arendale (1992) described as one the key features of the SI model that helps students apply the essential learning skills presented in the SI sessions to help students assess strengths in knowledge of the content as well as develop areas of challenge. Within the participation/interaction factor, most students worked actively with partners and/or small groups (89.7%) which supports the conclusions of previous studies that collaborative learning activities are essential to enhance self-esteem of the students and to encourage student engagement in their learning process which ultimately increases retention of course material that leads to higher levels of academic performance (Maxwell, 1997; Martin & Arendale, 1992; Tinto, 1993). Within the emotional engagement factor, most students felt comfortable working in groups (84.6%) and felt comfortable asking questions (82.1%) which is a significant component of the SI model that requires student SI leaders to facilitate the SI session, so SI participants have opportunities to openly acknowledge their academic challenges and share with their peers within the SI environment (Martin & Arendale, 1992). Within the performance engagement factor, most students studied for exams (80.8%; see Table 7) which the main premise of this engagement factor is to develop students' confidence levels in learning the mathematics content to do well on the tests in order to earn good grades in the course (Handelsman, et al. 2005).

In addition, most participants added comments about their activities during the SI sessions and the highest number of textual coded comments were related to participation/interaction engagement (47.1%), whereas the lowest number of textual coded comments was related to emotional engagement (7.9%). When participants were asked to select any additional resources that they used outside of the SI class sessions and the math class activities, the most commonly selected item was Google search (69.2%) and the least frequently selected item was private tutoring (14.1%; see Table 9). Furthermore, participants added comments about the additional resources used; the highest number of textual comments was related to study groups with friends (22.3%) followed by YouTube videos (20.7%). In contrast, the least number of textual codes of comments included use of phone and online apps (3.3%) and asking family members for help (3.3%; see Table 12). All of these additional uses of resources reported by the participants may contribute to the explanations of the additional factors that

Blanc, Debuhr, and Martin (1983) claimed that may have impacted higher levels of academic performance.

Research question one. The first research question that guided this study was, "To what extent, if at all, are any of the SI students' academic course engagement factors individually related to their gateway mathematics course grades?" The researcher hypothesized that there was a positive relationship with at least one of the four engagement factors to the gateway mathematics grades of the SI students. The results of this study supported this hypothesis. The data for each of the engagement factor scales indicated that participants reflected at least moderate characteristics of engagement in the gateway mathematics course (a minimum score of 3 represents moderate characteristics). Performance engagement represented the highest summed score for most characteristics of the students (M = 4.11) and the emotional engagement scale signified the lowest summed score (M = 3.26).

Similarly, Table 16 displayed that the participants who earned the higher grades of A or B showed a performance summed score range of 12-15 which is close to the upper end of the possible summed score range of 3-15 for the factor. On the other hand, these same participants that earned the A or B course grades displayed a broader emotional engagement summed score range of 7-25 which included the lower summed scores (Table 16). The participants who earned grades of C, D, or F for the midterm exam grade followed by C, D, or F for the overall current grade displayed lower performance engagement summed scores of a range of 6-14 (17%). In addition, the emotional engagement summed score range of 7-17 for these participants who earned the C, D, or F grades was significantly lower than the participants who earned the A or B grades. Likewise, each of the skills engagement summed score ranges and the participation summed scores were lower than the participants that earned the A or B. Dweck (2000) may consider that the participants who earned the C, D, or F grades could identify as entity learners who consider their poor performance as consistent with their self-belief of limited capacity or ability to learn the content; therefore, the participants exerted less efforts throughout the term and consequently earned the lower grade. Furthermore, Table 16 revealed that one participant that earned the D grade for the midterm exam grade and the C grade for the overall current grade showed a higher performance engagement summed score of 14 and skills engagement summed score of 41 which are close to the possible summed scores of 15 and 45, respectively. Even though the emotional engagement summed score was low, 15 and the participation engagement summed score was 16, it seems to be more difficult to determine whether this participant could identify as an entity learner or incremental learner. However, as Hansone and Harackiewicz (2000) proclaimed, it can be inferred that this participant could have increased his or her perceived goals which include target goals and purpose goals to improve the D midterm exam grade to the C overall current grade.

The data from the Pearson correlation model provided evidence for seven out of eight significant positive correlations between each of the four engagement factors and the midterm exam grades and overall current mathematics course grades. Therefore, the researcher rejected null hypothesis one. The performance engagement factor scale showed the highest positive correlation for both midterm grade (.62) and the overall current grade (.78) of the gateway mathematics course (Table 13). The skills engagement factor showed the lowest positive correlation to the overall current grade (.35). Although the skills engagement factor scale regression to the midterm exam grade was almost significant ($r = .22$, $p = .06$), the lowest significant positive correlation to the midterm exam grade was the emotional engagement factor (.35; see Table 13).

Research question two. The second research question that guided this study was, "To what extent, if at all, is the linear combination of the SI students' four academic course engagement factors related to their gateway mathematics course grades?" It was hypothesized that the combination of the four course engagement factors would be related to the grades of the SI students in the gateway mathematics course. The two multiple regression models revealed that the linear combination of the four engagement factors was related to both the midterm exam grade and overall current grade in the mathematics course. Therefore, these findings support the alternative hypothesis two, leading the researcher to reject null hypothesis two. The overall four variable model was significant (p = .001) and accounted for 40.7% of the variance in the midterm exam grade. This means that more than 40% of the variance in grades was related to the engagement factors and about 59% of the midterm exam grades were attributed to other factors of the college and personal experiences of the participants. The 40.7% variance in midterm exam grades was more than the regression results that revealed 28% of the variance of the midterm examination grades of the participants of the study conducted by Handelsman et al. (2005). Handelsman et al. (2005) concluded that the results of the midterm examination grades earned by the participants in their study may have been influenced by their extrinsic motivation to complete the exam since it was primarily graded on efforts of completion which included open book access while completing the exam. In contrast, the midterm examination completed by the participants in this study did not have the access of open book and the contents of the exam were based on knowledge of the course material and application of the concepts. Inspection of the beta weights found the midterm exam grade was positively related to performance engagement (β = .57, p = .001).

The overall four variable model regression was significant (*p* = .001) and accounted for 60.8% of the variance in the overall current course grade. This means that more than 60% of the influence on the overall current grades was related to the engagement factors and 39% of the variance was related to other factors of the college or personal experience of the participants which is consistent with Blanc, Debuhr & Martin's (1983) note that there was a potential of a combination of factors that influenced the higher levels of student academic performance. Inspection of the beta weights found the overall course grade was positively related to performance engagement ($\beta = .78$, *p* = .001; Table 14). The final regression results of the Handelsman et al. (2005) study revealed participation/interaction engagement factor as the only significant predictor of the final examination grades earned by the participants. Handelsman et al. (2005) mentioned that a large portion of the course grade was based on completion of assignments which may have required higher levels of skills engagement and participation/interaction engagement, thus impacted the variance in grades. However, this current study analyzed the overall current grade instead of the final examination grade which revealed the performance engagement factor as the significant predictor of the grades earned by the participants. This performance engagement factor may have been influenced by the extrinsic motivation of the participants to do well on the tests and earn a good grade since most of the course grade was based on examinations. Handelsman et al. (2005) concluded that behavior of the participants to do well on the tests may have been attributed to their desire to learn the material which Dweck (2000) may have described this behavior as representative of the incremental learner. In addition, other factors that involved participation in the SI sessions such as studying for the exams may have impacted the overall course grades of the participants in this current study.

Conclusions

Three conclusions are supported by the findings from this study.

Student engagement and academic performance. Given the linear and positive relationships between the four engagement factors and the academic performance of gateway mathematics course grades of the 78 SI students who participated in this study, the researcher concludes that engagement is a multi-dimensional construct and the more students are engaged in their studies it is likely to result in higher grades in the mathematics course (Burch, 2015; Kahn, 1990; Handelsman et al., 2005; Lee, 2014). Although most of the SI students scored moderately characteristic in each of the four engagement factors of skills engagement, participation/interaction engagement, emotional engagement and performance engagement, the findings of this study have revealed that performance engagement was a significant predictor of better grades. This finding is aligned to Martin and Arendale's (1992) conclusions that positive relationships exist between highly motivated students and their perceived course performance. Similarly, Dweck (1999) asserted that performance goals are critical to achievement, and sometimes students have problems when proving their ability becomes so important that it drives out learning goals. Furthermore, Molden and Dweck (2000) proclaimed that performance goals of students suffer most after a failure experience during the course. The findings of this study revealed a high percentage of participants earned a C or better for the midterm exam grade (96.2%) and overall current grades of C or better (93.6%), and most participants with these grades reported a moderate level of performance engagement throughout the term. However, the summed scores of the performance engagement factor tended to be lower for the students who earned a C, D, or F for the midterm exam grade then reported an overall current grade of C or higher (see Table 16). These findings appear to support Molden and Dweck's (2000) conclusions that students may have decreased engagement in their studies after their low performance experience with the midterm exam grades.

Furthermore, the researcher concluded that since the data revealed a near significant correlation of skills engagement (.22) to the midterm exam grade, these findings may imply that with the high percentage of freshman/first year SI students (85.9%), during initial weeks of the course prior to the midterm, many students may have possessed low academic abilities or lacked essential study skills to perform well on the first exams. This result aligns with Heller and Marchant's (2015) findings of strong correlations between low-achieving and high achieving students and the ability to self-regulate with their studies. Self-regulation learning strategies help students learn ways to master content and apply it in their courses which may improve learning outcomes. Similarly, Cukras (2006) maintained that first-time college students need academic assistance to become independent self-regulated learners which involves development of skills related to this engagement factor.

The researcher concurs with the literature that students' engagement within the mathematics course and the SI sessions plays an integral role of student success in the mathematics course, as evidenced by the high percentage of students who earned an overall current grade of C or better (93.6%) in the mathematics course (Briggs et al., 2004; Burch, 2015; Handelsman et al., 2005; Lee, 2014; Svanum & Bigatti, 2006). Svanum and Bigatti (2009) asserted that high levels of student engagement and effort in academic courses during a semester are significant predictors of college success. Likewise, previous research of Handelsman et al. (2005), Svanum and Bigatti, and Burch et al. (2015) highlights the importance of high levels of student engagement, which is a significant predictor of greater academic performance in course grades, consistent persistence towards enrollment in subsequent semesters, and ultimate college success.

Academic support and academic performance. Based on this study's findings that participants relied on many opportunities for instructional support from the SI program and additional resources to help them learn the mathematics content, the researcher concludes that academic support and resources are essential for learning. "SI is designed to increase student academic performance and has an indirect positive effect on student retention and ultimate graduation" (Martin & Arendale, 1992, p. 20). SI sessions promote engagement in social interactions by enhancing involvement in learning and elevating the quality of student effort in the learning process, which provides a promising vehicle for enhancement of student retention (Martin & Arendale, 1992; Tinto, 1993). Based the results of this study, regular interaction with the instructors and the SI leaders seemed to affect participants' level of engagement in their academic studies. In addition, regular interactions with peers during collaborative activities within the SI program in addition to peer study groups beyond the SI class and the mathematics class has been effective in participants maintaining a moderate level of engagement in the factor of participation/interaction. This was evidenced by one participant's comment, "Working in small groups in class was great because we would all get together to solve practice problems and when someone wouldn't understand a concept they could get help from another person within the group and vice versa." Another participant noted,

> Meeting with the SI leader helped me get one on one help because sometimes I felt like everyone around me thought the material was easy and that I was the only one struggling. So, it was nice to focus on teaching tailored to my needs.

Tinto (1993) asserted that collaborative learning is as important as learning the content, and students who remain actively engaged in their education activities during their first year in college enhances their learning experiences and improves retention.

Although the regression analysis did not reflect significant relationships of the use of additional resources to the participants' course grades, the participants added comments that other resources helped them further learn the content of the mathematics course. For instance, one participant noted, "Going to the learning center almost every day helped me with completing all assignments with an A and taught me more about my mistakes and how to revise them." Likewise, another participant expressed, "Getting help from family really helps because they have experience." A participant commented, "Googling material I didn't quite understand 100% helped me solidify what we learned in my math course." One participant stated, "The thing that helped me out the most was YouTube videos since the ones I watched were very simple, clear and concise which were best to get the topic of this type of math across to me." A participant responded, "Using apps to help with graphs helped me visually learn." These comments show that 21st century learners tend to rely on a variety of academic resources, especially technology tools to supplement their learning of content from the classroom (Trilling & Fadel, 2009).

Academic performance and persistence. Based on the findings that most students earned an overall current grade of C or better (93.6%) with most participants earning grades of A or B (71.8%), and only 5% withdrawals from the course, by the end of the Fall 2017 term, it is concluded that most students persisted to complete the mathematics course. In addition, the researcher concludes that most students will potentially persist towards enrollment in the Spring 2018 term, since Svanum and Bigatti (2009) noted that higher course grades (which impact the overall GPA) increase the probability of degree completion, potentially decrease the time of degree completion, and increase grade-measured college success. Moreover, Belcheir (2005) and Budney et al. (1998) stated that mathematics students who earn an A or B during the first semester are likely to persist to enrollment in subsequent semesters. Svanum and Bigatti asserted, “Student motivation that translates into more engagement can tangibly improve college success, encourage self-sufficiency, and allow students to exert greater control of their college destiny” (p. 131).

Implications for Policy and Practice

This study was designed to investigate the relationships between four student engagement factors and the gateway mathematics course grades among college students enrolled in an SI course while concurrently enrolled in the attached gateway mathematics course. The findings may have implications for policy and practices aimed at improving academic outcomes of SI students enrolled in gateway mathematics courses in 4-year colleges and universities. There are two implications for policy and practice based on the findings of this study.

Policy. It is recommended that collaborative efforts of program design continue among the key facilitators of the SI program and the faculty of the mathematics department, potentially including discussions of sources that integrate a variety of student-centered opportunities that promote academic success in the gateway mathematics courses. Pace (1984) asserted that “accountability for achievement and related student outcomes must consider both what the institution offers and what the students do with those offerings” (p. 6). It is recommended that the institutional academic support programs such as the SI programs, learning centers, and STEM and non-STEM departments continue to provide students with a variety of venues of campus access to academic support and resources to keep them engaged in personal learning. Moreover, the facilitators of these programs—including the SI coordinators, the SI leaders, the faculty, and the staff—must work collaboratively to continue to monitor student progress by assessing student persistence within the course term, regularly surveying students and faculty on what works for maintaining high levels of student engagement, and promoting positive student learning outcomes, especially in academic performance.

Practice. Academic course success is a significant predictor of persistence and higher rates of retention. Briggs et al. (2004) suggested that early detection of student engagement and implementation of best practices during a course term can positively affect student behaviors and attitudes, which may lead to positive learning outcomes. Sims et al. (2008) asserted that learner engagement leads to effective outcomes. Since this study revealed that engagement was multidimensional, then faculty, SI leaders, and other facilitators of learning must continue to provide opportunities for students to engage in personal learning during their classroom experiences.

Given that performance engagement was a significant indicator of student grades and the foundations of this engagement factor promote student confidence levels to learn math content, do well on tests, and earn a good grade, then facilitators of student learning must integrate all of the engagement factors to increase and/or maintain these confidence levels. Auster (2016) maintained that students' positive perceptions, especially relating to self-efficacy, influence progress. Therefore, increased self-efficacy may contribute to increased levels of engagement and involvement in personal learning; subsequently, increased participation in personal learning leads to potential for improved learning outcomes. McDonald (2012) defined self-efficacy as an individual's personal belief in the strength of his/her personal abilities to learn, complete tasks, and reach goals. This definition supports Dweck's (1999) self-learning theory, which asserts that learners must have confidence in their learning in order to persists with increased levels of effort and attain performance and learning goals. Bandura (1977) suggests that self-efficacy can be influenced by performance accomplishments and verbal persuasion. Facilitators of learning must create learning environments that foster positive mindsets and frequently celebrate accomplishments to help students boost their confidence levels. Likewise, frequent positive feedback may increase the students' perception of their capabilities which may increase their motivation to do well on their exams. Furthermore, Martin & Arendale (1992) proclaim that mastery of content is critical to increasing self-confidence thus the SI model provides exemplary strategies and tools to help students remain involved in their learning processes.

Furthermore, as evidenced in the age range of 18-28 years old of the participants in this study which includes the Millennials and Generation Z, then customized student success models must be designed to help these 21st Century learners maximize their learning experiences and become independent learners. The designers and facilitators of these success models must be mindful of the characteristics of the different generations of learners while focusing on the best practices to help these learners engage in their learning experiences. Within these success models, facilitators of learning must provide these 21st Century learners opportunities to embrace social learning environments such as Instagram, and Facebook (Loveland, 2017). Learners must be allowed to utilize digital tools such as Skype, Google Hangouts, and learning management systems chat rooms or discussion boards to extend their networks of studies outside the classroom. Stein & Wanstreet (2008) proclaimed that chat rooms are avenues where students can share their experiences and participate in meaningful discussions through real time and anyplace settings. Also, since Generation Z learners tend to be more dependent on using digital learning tools then these learners must be provided customized direct access to new unlimited information through on-demand services with low barriers to access such as Google search engines, Youtube videos and online applications (Loveland, 2017). Furthermore, since Generation Z learners are typically self-reliant, then facilitators of learning must design immersive educational experiences that show students how to use academic resources and tools, so they can actively participate in their learning processes (Seemille & Grace, 2016). Finally, these customized success models must incorporate regular professional learning opportunities for facilitators of learning to maintain knowledge of emerging trends of best practices to engage students in their learning processes. McLester (2011) found that regular training helps equip facilitators of learning with tools and diverse skill sets to foster student learning.

Recommendations for Further Research

This study sought to extend the existing research on the effects of student engagement levels of SI students within the mathematics class and the SI course on academic outcomes of gateway mathematics course grades. However, this study had several limitations that could be potentially addressed through future research studies. Those limits include the involvement of only one CSU campus, a small sample of SI students, self-reported data, and the study's research design. Taking these limitations into consideration, the researcher proposes six recommendations for further study.

Recommendation one. A multiple case study targeted toward several similar universities may provide a greater range of data from a larger sample that would contribute to generalizability of the engagement factors that are best predictors of student academic outcomes in the gateway mathematics course (Creswell, 2009). In addition, a larger sample of students that includes SI students and non-SI students may expand the opportunity to gather a greater diversity of student backgrounds, especially demographics and major fields of study that include STEM and non-STEM students. In addition, the research would allow for inclusion of more sections of each level of gateway mathematics course, such as introductory level-pre-calculus and advanced level-calculus. Doing so would enable the researcher to gather a larger data set to compare relationships of engagement factors to course grades within each level of mathematics course.

Recommendation two. Since the findings of background information of this study showed many Hispanic (53.8%) and Asian-Pacific Islander (32.1%) participants, a broad range of ages from 18-28, and multiple classifications and major fields of study, it is suggested that further research examines how individual differences affect the class environment to engagement in the learning process and academic performance. Burch et al. (2015) argued that differences such as personality, age, gender, ethnicity, learning styles, etc. may potentially affect student engagement. Although the SI model emphasizes the collaborative model to encourage interactions with students of different backgrounds, it would be interesting to investigate how the professors of the lecture mathematics courses account for individual differences in engagement levels during delivery of instruction of course content.

Recommendation three. Self-reported data can affect the validity and reliability of a study's results, since participants may respond to prompts with bias, exaggeration, or reluctance to report what they actually think, believe, or do (Gonyea, 2005). Gonyea (2005) recommended that in addition to self-report procedures, researchers should:

> Use multiple data sources or triangulation rather than relying solely on self-reported data for making policy decisions. For example, self-reported data can be compared alongside student exit interviews, focus groups, faculty surveys, or transcript analyses. If information from differing sources appears to convey a consistent message, then the trustworthiness of the message is more secure. (p. 84)

Recommendation four. Since this quantitative study revealed specific results on the correlations of the student engagement factors to the math course grades, an extension of this study would focus on deeper analysis of the variance in grades—particularly which students earned the A grade, the B grade, the C grade, etc.—in relationship to the levels of each engagement factor and the linear combination of the engagement factors. In addition, a follow-up to this quantitative study could be a qualitative study to further explore the experiences and perspectives of the students, SI coordinators, SI leaders, and gateway mathematics course faculty. Qualitative research aims to understand people's uniqueness in experiences within a context and gain the participants' perspective (Creswell, 2009). Within educational research, qualitative approaches aim to improve effectiveness of professional practice and systems (Atkins & Wallace, 2012).

Recommendation five. Handelsman et al. (2005) recommended that "further validation of the student engagement measure could also focus on the relation of the measure to other constructs" (p. 190), such as identification of antecedents of student engagement that will enable educators to consider interventions to promote engagement. The literature suggests that teacher behaviors often influence the level of student engagement in the classroom. Also, Burch et al. (2015) suggested that further research should focus on how active learning activities for the 21st century learner such as simulations, group projects, and technology affect student engagement.

Recommendation six. Since this study focused on traditional face-to-face sessions in SI programs and gateway mathematics lecture courses, the researcher suggests that further studies concentrate on other modes of instructional delivery and academic support, such as virtual SI programs and blended learning environments that combine online and face-to-face instruction. This further research may expand the existing knowledge of the benefits of the VSI that have been offered at many post-secondary institutions within the United States since 1997 (Hurley et al., 2006). With the expansion of distance education and increasing needs for greater accessibility and flexibility for participants in higher education, blended learning has become a prominent approach for post-secondary institutions, including more students choosing to enroll in online gateway mathematics courses (Pombo, Loureiro, & Moreira, 2010). Future research could begin to determine the differences, if any, in levels of student engagement and the effects on learning outcomes, including academic performance (Burch et al., 2015).

Final Thoughts

After reviewing the data, the researcher is convinced that the behaviors in which students engage during their academic studies are essential for developing their personal learning and academic performance (Svanum & Bigatti, 2009). As Pace (1984) contended, the more a person participates in the aspects of his or her college experience and the more he or she puts into his or college experience, the more he or she will benefit from it. Similarly, Mayhew et al., (2016) concluded that, "Students' academic effort and involvement are positively related to desired outcomes including: intellectual and social gains, subject matter competence, and personal and social competence" (p. 551).

Although the literature showed that engagement is multidimensional, the results of this study revealed that performance engagement is significantly related to academic performance, then it is up to all stakeholders in the facilitation of student learning experiences to integrate the four factors of student engagement and provide opportunities for academic support and resources to increase or maintain students' confidence levels to learn and do well in mathematics; ultimately, the desired outcome is higher rates of positive academic performance. Furthermore, the members of the professional learning communities within the colleges and universities must carry on collaboration of ideas for best practices to stimulate engagement in all aspects of the students' college experience to encourage them to succeed in each academic course so they can persist towards college completion (Gonyea & Kuh, 2009; Tinto, 1993).

At the end of the day, from the commencement of a college student's educational journey with any gateway courses, especially STEM courses, it is the equitable duty of the institution and the students to remain involved in every aspect of the students' college experience towards college success (Pascarella & Terenzini, 2005). In return, proponents of college completion, such as Complete College America, believe that college success produces several positive impacts on the community such as students gaining opportunities for higher skilled jobs thus increasing the potential for higher salaries; promoting a stronger economy in the communities, the states and the country; and building a competitive global economy (Time is the Enemy, 2011). In the long run, it is up to our society and professional learning communities to actively participate in helping students successfully complete all courses during their college journey, especially within the first two years of college which gives them a sense of accomplishment and motivates them to persist towards college completion (The Game Changers, 2013).

Three scriptures sum up the vision of foundational principles for colleges and universities to foster engagement of students in their endeavors of academic excellence towards moving through gateway courses towards the prize of college completion. Psalms 37:23 states, "The steps of a good man are ordered by the Lord." Hence, no matter what pathway college students choose, STEM or Non-STEM career fields, it is essential to remain committed to the plans that God has designed for their purpose and destiny in their life endeavors. God delights to see His people and as our young people embark on their college journey, they must be reminded of the scripture, Jeremiah 29:11, "God has plans to prosper you and not harm you, plans to give you hope and a future." Therefore, college students must believe in their purpose, remain actively engaged in their college experiences, and with determination, rely on the scripture, Philippians

4:13, “I can do all things through Christ who strengthens me,” to help them persist towards college completion.

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APPENDIX A

IRB Approval

PEPPERDINE

Pepperdine University
24255 Pacific Coast Highway
Malibu, CA 90263
TEL: 310-506-4000

NOTICE OF APPROVAL FOR HUMAN RESEARCH

Date: November 10, 2017

Protocol Investigator Name: Keisha Lee

Protocol #: 17-10-644

Project Title: An Investigation of Engagement Factors Employed by Supplemental Instruction Students and the Relationships to Their Gateway Mathematics Course Grade at California State University in Southern California

School: Graduate School of Education and Psychology

Dear Keisha Lee:

Thank you for submitting your application for exempt review to Pepperdine University's Institutional Review Board (IRB). We appreciate the work you have done on your proposal. The IRB has reviewed your submitted IRB application and all ancillary materials. Upon review, the IRB has determined that the above entitled project meets the requirements for exemption under the federal regulations 45 CFR 46.101 that govern the protections of human subjects.

Your research must be conducted according to the proposal that was submitted to the IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit an amendment to the IRB. Since your study falls under exemption, there is no requirement for continuing IRB review of your project. Please be aware that changes to your protocol may prevent the research from qualifying for exemption from 45 CFR 46.101 and require submission of a new IRB application or other materials to the IRB.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite the best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the IRB as soon as possible. We will ask for a complete written explanation of the event and your written response. Other actions also may be required depending on the nature of the event. Details regarding the timeframe in which adverse events must be reported to the IRB and documenting the adverse event can be found in the *Pepperdine University Protection of Human Participants in Research: Policies and Procedures Manual* at community.pepperdine.edu/irb.

Please refer to the protocol number denoted above in all communication or correspondence related to your application and this approval. Should you have additional questions or require clarification of the contents of this letter, please contact the IRB Office. On behalf of the IRB, I wish you success in this scholarly pursuit.

Sincerely,

Judy Ho, Ph.D., IRB Chair

Page: 1

APPENDIX B

CSEQ Item Usage Agreement

CSEQ

Item Usage Agreement
College Student Experiences Questionnaire
Assessment Program

The College Student Experiences Questionnaire Assessment Program is part of the Indiana University Center for Postsecondary Research. The CSEQ Assessment Program is home to the *College Student Experiences Questionnaire (CSEQ)* and the *College Student Expectations Questionnaire (CSXQ)*. These are copyrighted survey instruments, and the copyrights are owned by The Trustees of Indiana University. Any use of survey items contained within the *CSEQ* or *CSXQ* is prohibited without prior written permission from Indiana University. When fully executed, this Agreement constitutes written permission from the University, on behalf of the CSEQ Assessment Program, for the party named below to use an item or items from the *College Student Experiences Questionnaire* or *College Student Expectations Questionnaire* in accordance with the terms of this Agreement.

In consideration of the mutual promises below, the parties hereby agree as follows:

1) The University hereby grants **Keisha Lee** ("Licensee") a nonexclusive, worldwide, irrevocable license to use, reproduce, distribute, publicly display and perform, and create derivatives from, in all media now known or hereafter developed, the item(s) listed in the proposal attached as Exhibit A, solely for the purpose of including such item(s) in the survey activity described in Exhibit A, which is incorporated by reference into this Agreement. This license does not include any right to sublicense others. This license only covers the survey instrument, time frame, population, and other terms described in Exhibit A. Any different or repeated use of the item(s) shall require an additional license.

2) In exchange for the license granted in section 1, Licensee agrees:

   a) to provide to the *CSEQ Assessment Program* frequency distributions and means on the licensed item(s);

   b) in all publications or presentations of data obtained through the licensed item(s), to include the following citation: "Items *xx* and *xx* used with permission from the *CSEQ Assessment Program, Indiana University,* Copyright 1998, The Trustees of Indiana University";

   c) to provide to the *CSEQ Assessment Program*, a copy of any derivatives of, or alterations to, the item(s) that Licensee makes for the purpose of Licensee's survey ("modified items"), for the *CSEQ Assessment Program's* own nonprofit, educational purposes, which shall include the use of the modified items in the *CSEQ*, *CSXQ* or any other survey instruments, reports, or other educational or professional materials that it may develop or use in the future. Licensee hereby grants the University a nonexclusive, worldwide, irrevocable, royalty-free license to use, reproduce, distribute, create derivatives from, and publicly display and perform the modified items, in any media now known or hereafter developed; and

d) to provide to the *CSEQ Assessment Program* for its own nonprofit, educational purposes, a copy of all reports, presentations, analyses, or other materials in which the item(s) licensed under this Agreement, or modified items, and any responses to licensed or modified items, are presented, discussed, or analyzed. The *CSEQ Assessment Program* shall not make public any data it obtains under this subsection in a manner that identifies specific institutions or individuals, except with the consent of the Licensee.

The undersigned hereby consent to the terms of this Agreement and confirm that they have all necessary authority to enter into this Agreement.

For The Trustees of Indiana University:

________________________ 9-1-17

Robert M. Gonyea — Date

Associate Director, Center for Postsecondary Research
Director, CSEQ Assessment Program
Indiana University

APPENDIX C

SCEQ Instrument Request and Response

PEPPERDINE

Keisha Lee 'student' <keisha.lee@pepperdine.edu>

SCEQ Instrument Request

3 messages

Keisha Lee 'student' <[redacted] Mon, Aug 28, 2017 at 9:17 PM
To: [redacted]

Hello Dr. Handelsman,

My name is Keisha Lee, a doctoral student @ Pepperdine University in California. I am currently writing the proposal of my dissertation on a study of Engagement Strategies Employed by Students in Gateway Mathematics Courses at a Four-Year University. As I read the results in your article (2005): A Measure of College Student Course Engagement, I found your SCEQ Instrument interesting for potential use in my cross sectional study of a semester mathematics course to assess engagement of students that impacted their final course grades.

I was wondering if the SCEQ instrument is available for review and potential use for my study?

If you are interested, would you consider speaking with me further about the instrument at your earliest convenience?

Thanks much,
Keisha Lee
Doctoral Student

Handelsman, Mitch <[redacted] Wed, Aug 30, 2017 at 8:16 AM
To: Keisha Lee 'student' [redacted]

Hi Keisha,

Here is the scale for your review and use. I've actually not used the scale in many years (since the project described in the AMATYC article), so I'm not sure how helpful I can be. But feel free to contact me with questions and I'll let you know if I can answer them!

Good luck on the project!

Cheers,

--mitch

Mitchell M. Handelsman, Ph.D.
Professor of Psychology
CU President's Teaching Scholar

Campus Box 173
University of Colorado Denver
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E-mail: [redacted]
Phone:
Fax:
Web:

MY BLOG: "The Ethical Professor"

http://www.psychologytoday.com/blog/the-ethical-professor

MY BOOKS:

http://www.amazon.com/author/mitchhandelsman

From: Keisha Lee 'student' [mailt[redacted]
Sent: Monday, August 28, 2017 10:17 PM
To: Handelsman, Mitch
Subject: SCEQ Instrument Request

[Quoted text hidden]

3 attachments

SCEQ - Scoring.doc
26K

SCEQ.doc
27K

AMATYC_Engagement_Final.pdf
132K

Keisha Lee 'student' <k[redacted] Wed, Aug 30, 2017 at 12:10 PM
To: "Handelsman, Mitch"[redacted]

Hi Dr. Handelsman,

Thank you very much for sending me the SCEQ questionnaire, Scoring Doc and Literature on Engagement. I appreciate you taking the time to assist me as I gather the best instrumentation for my research study. I will surely contact soon with some additional questions.

I hope your new academic year is off to a great start!

Best,

Keisha Lee,
Doctoral Student,
Pepperdine University
[redacted]

APPENDIX D

Survey Instrument

Default Question Block

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PEPPERDINE UNIVERSITY

(Education Leadership, Administration and Policy)

INFORMATION SHEET AND INFORMED CONSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

Please understand that your participation in this study is strictly voluntary. The following is a description of what the study participation entails, the terms for participating in the study and a discussion of your rights as a study participant. Please read this information carefully before deciding whether or not you wish to participate.

The purpose of this study is to investigate your level of engagement in your mathematics class and your supplemental instruction class and to determine the relationships to your math course grade.

If you should decide to participate in this study, you will be asked to complete a survey. It should take you approximately 10 minutes to complete the survey. The survey items consist of demographic information, behaviors, thoughts and feelings pertaining to your engagement in your mathematics class and your supplemental instruction class Please complete the survey alone in a single sitting.

Although minimal, there are potential risks that you should consider before deciding to participate in this study. These risks may include discomfort of time to complete the survey. If you are interested in the results of this study, please contact me and I will provide you with a summary of the findings.

If you should decide to participate and find you are interested in completing the survey in its entirety, you have the right to discontinue at any point without being questioned about your decision. You also do not have to answer any of the questions on the survey that you prefer not to answer- just leave such items blank. Your status as student will not be affected in any way based on your participation or non-participation in this study.

CONFIDENTIALITY

You will not be asked to provide your name or school location, and no IP address will be tracked; therefore, your identity will remain completely anonymous. All data will be kept in a secure manner for 5 years.

If you have questions regarding the information that I have provided above, please do not hesitate to contact me at the address and phone number provided below. If you have further question or do not feel I have adequately addressed your concerns, please contact my dissertation chairperson, Dr. Stephen Kirnon, at (310) 568-5600. If you have questions about your rights as a research participant, contact Dr. Judy Ho, Chairperson of the Graduate & Professional Schools Institutional Review Board at Pepperdine University 6100 Center Drive Suite 500 Los Angeles, CA 90045, 310-568-5753 or gpsirb@pepperdine.edu.

By completing the survey and returning it to me, you are acknowledging that you have read and understand what your study participation entails and are consenting to participate in the study.
Thank you for taking the time to read this information, and I hope you decide to complete the survey.

Sincerely,
Keisha Lee
[redacted]

. Do you agree?

- I agree to participate. Take me to the survey.
- I do not agree to participate.

. Background Information:
Please indicate your response by filling in the appropriate bubble next to your answer.

a. What is your age?

b. What is your gender?

- Male
- Female
- Prefer not to designate

c. What is your racial or ethnic identification?

- American Indian or Native American
- Asian or Pacific Islander
- Black or African American
- Caucasian (other than Hispanic)
- Hispanic/Latina(o)
- Other
- I choose not to answer

d. What is your classification in college?

- Freshman/first year
- Sophomore/2nd year
- Junior/3rd year
- Senior/4th year
- Senior/5th year
- Unclassified

e. Which of these fields best describes your major? You may indicate more than one if applicable.

- Biological/Life Sciences (biology, zoology, etc.
- Business
- Computer and Information Systems
- Education
- Engineering
- Health Related Fields (nursing, kinesiology
- Humanities (English, philosophy, religion, etc.
- Liberal/general Studies
- Mathematics
- Physical Sciences (physics, chemistry, etc.
- Pre-Professional (pre-dental, pre-medical, etc.
- Social Sciences (economics, psychology, political science, etc.
- Visual Performing Arts (Art, music, etc.
- Undecided
- Other

f. Did you begin college here or did you transfer from another institution?

- Started here
- Transferred from a community college
- Transferred from a private technical college
- Transferred from another institution

g. What is your current overall grade point average (GPA) at this institution?

h. What math course did you take for Fall 2017 Term?

i. What is your overall current grade in your Mathematics Course?

- A
- B
- C
- D
- F

j. What grade did you earn for your midterm exam in your Mathematics Course?

- A
- B
- C
- D
- F

k. How many course credit units are you taking this term?

- 6 or fewer
- 7-11
- 12-14
- 15-16
- 17 or more

l. During this semester, about how many hours a week did you spend outside of math class activities and SI class studying for this mathematics course?

- 5 or fewer hours a week
- 11-15 hours a week
- 6-10 hours a week
- more than 15 hours

m. About how often did you use a campus learning lab or center to improve your math skills?

- Very often
- Occasionally
- Often
- Never

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STUDENT ENGAGEMENT QUESTIONNAIRE

To what extent do the following behaviors, thoughts, and feelings describe *you, in your mathematics course.* Please rate each of them on the following scale:

5 = very characteristic of me
4 = characteristic of me
3 = moderately characteristic of me
2 = not really characteristic of me
1 = not at all characteristic of me

1. Raising my hand in math class

5	4	3	2	1
○	○	○	○	○

2.
Participating actively in small group discussions in math class

5	4	3	2	1
○	○	○	○	○

3.
Asking questions when I don't understand the math instructor

5	4	3	2	1
○	○	○	○	○

4.
Doing all the homework problems

5	4	3	2	1
○	○	○	○	○

5.
Coming to math class every day

5	4	3	2	1
○	○	○	○	○

6.
Going to the professor's office hours to review assignments or tests, or to ask questions

5	4	3	2	1
○	○	○	○	○

7.
Thinking about the math course between class meetings

5	4	3	2	1
○	○	○	○	○

8.
Finding ways to make the math course interesting to me

5	4	3	2	1
○	○	○	○	○

9.
Taking good notes in math class

5	4	3	2	1
○	○	○	○	○

10.
Looking over class notes between classes to make sure I understand the material

5	4	3	2	1
○	○	○	○	○

11.
Really desiring to learn the material

5	4	3	2	1
○	○	○	○	○

12.
Being confident that I can learn and do well in the math class

5	4	3	2	1
○	○	○	○	○

13.
Putting forth effort in my math class

5	4	3	2	1
○	○	○	○	○

14.
Being organized

5	4	3	2	1
○	○	○	○	○

15.
Getting a good grade in this math class

5	4	3	2	1
○	○	○	○	○

16.
Doing well on the math tests

5	4	3	2	1
◯	◯	◯	◯	◯

17.
Staying up on the readings

5	4	3	2	1
◯	◯	◯	◯	◯

18.
Having fun in class

5	4	3	2	1
◯	◯	◯	◯	◯

19.
Helping fellow students in the math class

5	4	3	2	1
◯	◯	◯	◯	◯

20.
Making sure to study on a regular basis

5	4	3	2	1
◯	◯	◯	◯	◯

21.
Finding ways to make the course material relevant to my life

5	4	3	2	1
◯	◯	◯	◯	◯

22.
Applying course material to my life

5	4	3	2	1
◯	◯	◯	◯	◯

23.
Listening carefully in math class

5	4	3	2	1
◯	◯	◯	◯	◯

. Please respond to the following 3 questions about your SI attendance, SI participation and use of other learning resources.

24. **About how many times did you attend SI class this semester?**

____

25a. **Please select any of the listed activities that you participated during your SI sessions. (Check all that apply)**

- ☐ Reviewed lecture notes
- ☐ Actively worked with partners and/or small groups
- ☐ Felt comfortable asking questions
- ☐ Completed practice quizzes
- ☐ Worked out practice problems
- ☐ Helped other students
- ☐ Felt comfortable answering questions
- ☐ Studied for exams
- ☐ Learned helpful study strategies
- ☐ Met with SI leader for extra help
- ☐ Felt comfortable working in groups
- ☐ Reflect on and/or Self-correct math class exams

25b.
Please comment on two or three of the above activities of the SI sessions that most helped you learn the math content in your math class? Add any activities that were not on the above list.

***26a.* Please select any of the listed additional resources that you used on campus, off campus, at home or online besides the SI class and the mathematics class. (Check all that apply)**

- ◯ Went to learning center
- ◯ Private tutoring
- ◯ Used phone or online apps
- ◯ Youtube videos
- ◯ Attended small study groups with friends
- ◯ Asked family members
- ◯ Online study website
- ◯ Google search

26b.
Please comment on two or three of the resources that most often helped you learn the math content in your class. Add any additional resources that were not listed above.