Examining Relationships of Collegiate Experiences, Gender, and Academic Area with Undergraduate Students' Collaborative Learning Skills

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ABSTRACT

Collaborative learning skills are one of the essential learning outcomes for a college education in 21st century. College students are expected to possess the ability to collaborate with others in order to succeed in their career after graduating from college. However, the effects of collegiate experiences on collaborative learning for different gender and academic areas are almost unexplored. In addition, researchers highlight the need for more research on interaction effects to explore whether different types of students respond differently to various collegiate experiences. The researcher examined the relationship of student-student interactions and student-faculty interactions with graduating seniors' perceived collaborative learning skills. Furthermore, the researcher explored whether this relationship was moderated by students' gender, academic area, and retrospective perception of their collaborative learning skills.

Social-cognitive learning theory and Astin's involvement theory were used as conceptual frameworks to guide this study. Astin's input-environment-output college impact model served as a theoretical guide. Using an institutional cross-sectional data set, multiple regression analysis was utilized to examine these relationships. According to the results, the relationship between student-student interactions and graduating seniors' perceived collaborative learning skills was positive after controlling for the other independent variables in the study. Further results revealed that the relationship of student-student interactions and student-faculty interactions with the outcome variable was moderated by students' gender, academic area, and retrospective perception of their collaborative learning skill. The relationship between student-faculty interactions and the outcome variable was significantly weaker for male students, whereas the

relationship between student-student interactions and the outcome variable was weaker for female student. The relationship between student-faculty interactions and the outcome variable was weaker for students in hard pure academic areas when compared to students in soft applied academic areas, while the opposite was observed for the relationship between student-student interactions and the outcome variable. The findings of the present study can be used to shape students' interactions with faculty and their peers with the awareness that these impact different types of students in different ways.

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Chapter 1

Introduction

Background

In the United States a relatively high percentage (75%) of high school graduates receive a postsecondary education (Ramaley & Leskes, 2002). Student enrollment in college is expected to grow in the coming years from 17.6 million students in 2009 to 20.0 million in 2020 (Aud et al., 2011). It is central to national higher education policy that the number of students in the United States receiving a college degree is increased (Obama, 2009). Another goal of higher education is to attract an increased number of international students which enhances the participation in the global knowledge economy (Altbach & Knight, 2007). The high rate of student enrollment in higher education and the number of students who enroll to complete degree are good news; however, there is still space for improvement in opportunities for all students to get all of the benefits a college education can provide. Experts are concerned about all students having access to collegiate benefits. Both state and federal agencies have put forth effort to provide students with equal access to a college education (Terenzini & Reason, 2005; St. John, 2003; Datnow, Solorzano, Watford, & Park, 2010). Student success is one of the indicators of full access to those benefits; therefore, research conducted in this area is valuable to guide policy makers (Terenzini & Reason, 2005).

The focus on student learning has resulted in numerous discussions on what skills and abilities a college graduate should demonstrate as evidence of quality educational processes. The Association of American Colleges and Universities (AAC&U) has highlighted "essential learning outcomes" (AAC&U, 2007, p. 12) regardless of institutional type or discipline. Students are expected to demonstrate specific outcomes such as “intellectual and practical skills, including

inquiry and analysis, critical and creative thinking, written and oral communication, quantitative literacy, information literacy, and teamwork and problem solving" (p. 3). Essential learning outcomes include personal and social responsibility such as civic knowledge, intercultural knowledge, ethical reasoning, as well as skills for lifelong learning. Global and civic learning are identified by AAC&U as two important outcomes college educators should monitor entering the twenty-first century (Leskes & Miller, 2006). More than 70% of employers expect "teamwork skills and ability to collaborate with others in diverse group settings" from college graduates (Hart Research Associates, 2010, p. 2).

Most disciplinary and regional accrediting bodies attempt to ensure that universities are focused on student learning and the development of skills that the Association of American Colleges and Universities label as "essential learning outcomes" (AAC&U, 2007, p. 12). Other skills highlighted include knowledge of human cultures and the physical and natural world, intellectual and practical skills, and personal and social responsibility. The AAC&U declared teamwork and attaining attitudes and skills of teamwork as one of the essential learning outcomes for a college education as it enables the development of collaborative skills of individual students and increases productive contributions to the groups they work with in college and in the work place. In almost every organization collaborative work is necessary and is a prerequisite for productivity (Hills, 2007; Kozlowski & Bell, 2003; Morgeson, DeRue, & Karam, 2010). The purpose is to assist students in becoming effective team members, with personality traits such as initiative, openness, helpfulness, flexibility and supportiveness (Kinlaw, 1991; Morgeson, Reider, & Campion, 2005; Stevens & Campion, 1994; Varney, 1989). Effective group members develop social skills such as "interpersonal perspectiveness and the capacity to adjust one's behavior to different situational demands and to effectively influence and control the

responses of others" (Ferris, Witt, & Hochwarter, 2001, p. 1076). Higher education leaders are expected to prepare students for future employment by fostering the skills listed above as well as "teamwork, critical thinking, open-ended problem solving skills, and effective communication skills" (Black, 1994; Coleman, 1996, p. 27)

Enhancing college students' collaborative learning not only benefits the individual but society as a whole.

> "Another challenge for higher education in the new social and global context is to continue to shape its own boundaries to allow for partnerships across and between different types of institutions to address public issues. A focus inward at its own practices, values, and social relevance and outward at its social impact, networking flexibility, and collaboratively-inspired innovations will be required of higher education as a network in the movement to strengthen higher education's covenant with society." (Kezar, Chambers, & Burkhardt, 2005, p. 6).

Many researchers have empirically examined the extent to which college fosters significant student development in a number of these areas such as critical thinking, social and personal competence, and collaborative learning for both traditional students and diverse student population (Astin, 1993; Pascarella & Terenzini, 1991, 2005; Renn & Reason, 2013). Collaborative learning enhances peer interactions in a college classroom and provides opportunities to improve students' social skills and lead to higher academic achievements. A positive relationship has been found between collaborative learning and conceptual gains, collaborative learning and positive attitudes about learning (Cooper, 1999) and persistence in college (Springer, Stanne, & Donovan, 1999). Other researchers examining the relationship between collaboration among college students and student outcomes demonstrated a positive

relationship between collaboration and educational gains (Kuh, Pace, & Vesper, 1997) and students' retention (Astin, 1993).

Teamwork as a practice of collaborative learning has been demonstrated as having effects on academic success, students' psychological health (Johnson, Johnson, & Smith, 1991), and their career choice (Colbeck, Campbell, & Bjorklund, 2000; Webb, 1991). Simply being exposed to collaborative learning environments enhances students' collaborative learning skills and enables them to collaborate effectively in subsequent projects (Colbeck et al., 2000). Research conducted on collaborative learning with both public school and college students indicated improved affective measures (Gillies, 2004; Slavin, 1995a).

Research conducted by Colbeck et al. (2000) on college students' perceptions of collaborative learning situations revealed that students believe collaborative learning and communication skills are developed and enhanced during team work and group projects. Further, college students perceived a positive impact of collaborative learning on their discipline-specific knowledge and interpersonal communication skills. In addition, learning of new technical knowledge is enabled by simply practicing problem-solving skills during group projects. Collaborative learning provides a social context where students not only acquire strategies and knowledge on the specific content but also strengthen their thinking in general (Slavin, 1995a; Slavin, 1995b). Researchers indicate that collaborative learning situations in which individuals of varied perspectives, learning styles, gender, and experiences work together are more beneficial to students than situations in which individuals of similar background participate (Hunkeler & Sharp, 1997; Rosser, 1998).

In collaborative learning situations certain forms of interpersonal interactions occur and these interactions activate the learning mechanism of individuals. In collaborative learning

individuals preferably are at the same level, have a common goal, interact in a collaborative way, and work together to reach that specific goal (Dillenbourg, 1999). Thus it is a joint attempt of two or more people to create a space in which they learn or try to learn something (Dillenbourg, 1999). Collaborative learning is an effective instructional method where interaction occurs among learners (Bernard, Rubalcava, & St. Pierre, 2000). This interaction help the learners to share their knowledge and skills as they reach a specific learning goal (So & Brush, 2008). Researchers propose that faculty and college administrators need to promote learning environments where college students' collaborative learning skills can be enhanced. This is considered necessary because many students apply their competitive skills in high school in order to be successful, but when they enter college they have difficulty adapting to collaborative learning environments in college settings (Bosworth, 1994). Schultz (1990) lists the reasons why college students fail to be successful in such learning environments. According to his study college students either lack the necessary skills for collaborative learning or they cause interpersonal problems by competing with each other, jockeying for leadership positions, failing to listen to each other or share ideas, or not respecting the others and their ideas.

Definitions of Terms

Collaboration: "Collaboration is to work with another or others." (Barkley, Cross, & Major, 2005). The following definition of collaboration further expands on the first definition. "Collaboration is a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem" (Roschelle
& Teasley, 1995, p.70).

Collaborative Learning: "Collaborative learning is two or more students laboring together and sharing the workload equitably as they progress toward intended learning outcomes." (Barkley et

al., 2005). The term collaborative learning used in this study has a broad scope and it captures learning beyond classroom.

CLS: This abbreviation for collaborative learning skills (CLS) refers to an individual's skills and abilities needed for an increased and successful involvement in collaborative learning.

Gaps in the Literature and Need for Study

The literature on college impact on student success is extensive in the study of higher education. Numerous research articles are available on enhancing the quality of students' education that can guide faculty members, higher education administrators, and policy makers. Much of that literature, however, is highly segmented, focuses on single variables and does not take into account student, faculty, or institutional variables influencing student outcomes and therefore lacks a comprehensive analysis of multiple variables (Terenzini & Reason, 2005). Further, existing research is mainly focused on traditional college students and does not take into account the changing characteristics of college students (Renn & Reason, 2013).

Despite the calls for excellence in higher education and monitoring the quality of undergraduate education, little new knowledge has been generated about indicators of educational practice that predict student engagement (Pascarella, 2001), approaches that faculty take to effective educational practices (Kezar, 1999), and college environment impacting students of diverse background (Renn & Reason, 2013). A better understanding is required about variables that contribute, both positively and negatively, to what matters most in learning. Although a lot is known about how faculty spend their time, what instructional techniques they used, and satisfaction with teaching (Menges, 2000), much less is known about how these variables influence gains in student learning.

Gender is one of the factors that affect collaboration and success of collaborative learning

(Tucker, Powell, & Meyer, 1995). The number of researchers examining gender effects in higher education collaborative learning environments is limited. In one study of a collaborative learning environment female students seem to have higher feelings of classroom community than male students (Summers, Beretvas, Svinicki, & Gorin, 2005). Other researchers explored the effect of gender composition of groups on collaborative learning and found that group structure can impact the success of the group and how group members communicate with each other (Tucker et al., 1995). Tucker et al. claimed that gender composition played a role in the success of group members and the group as a whole. Another study supported this claim and found that female collaborators benefit more from same-gender learning environments (Lee & Marks, 1990; Salomone, 2003). Little is known about the relationship between gender and students' collaborative behaviors as well as gender and the differences in other areas of student learning. Research designed to examine how college experiences affect students' collaborative learning skills and the nature of this relationship for different student groups is nearly unexplored.

Another factor influencing the relationship between college experiences and what students learn is study discipline. Colleges consist of different disciplines and individuals in these disciplines differ in terms of their expectations, perceptions, as well as their learning outcomes (Pike & Killian, 2001). Many researchers have examined the relationships between college experiences, learning outcomes, and selected background characteristics of students. Academic disciplines, for example, influence students' academic orientations, expectations, and perceptions of the college environment (Feldman, Smart, & Ethington, 1999; Pascarella, 1976). Evidence of how these traits vary by discipline includes investigations into critical thinking and problem solving. Researchers have found levels of critical thinking to be higher for students in disciplines such as engineering and science than for students majoring in education and the arts

(Astin, 1993; Whitt, Pascarella, Pierson, Elkins, & Marth, 2006). In another study, students in applied academic areas reported higher gains in vocational competence whereas they reported lower general educational gains than did students in pure disciplines (Pike & Killian, 2001). However, it was found that graduate students in the mathematical sciences had lower critical thinking scores than did graduate students in the social sciences (King, Wood, & Mines, 1990). The study conducted by Pike (1992) confirmed these results and reported that senior students in engineering and mathematics scored lower in college outcome measures than did seniors in business, the humanities and natural sciences, even after controlling for students' entering ability levels. Although researchers have examined how different study disciplines affect the relationship between college experiences and some learning outcomes such as critical thinking, problem solving and general educational gains, there is a need to explore the relationship between discipline and collaborative learning.

Purpose of the Study and Research Questions

The purpose of this study was to examine the relationships between gender, academic areas (hard pure, hard applied, soft pure, and soft applied), interactions with faculty and with other students, and students' perceived level of collaborative learning skills as graduating seniors and retrospective to their entering the university. The present research is a descriptive, non-experimental, cross-sectional study designed to address the gaps in the existing literature by examining collegiate experiences and collaborative learning which is a critical college outcome that leads to significant public benefits. Bowen (1977) proposes that postsecondary institutions need to influence development of social goals besides individual goals and states that higher education “sets in motion a dynamic process leading to changes in society, which in turn will lead to further changes in both individuals and society” (p.50). Moreover, he believes that a

student's attitudes, values, and behavior patterns can be influenced by the collegiate experiences, which can subsequently influence social change upon graduation (Bowen, 1977). Although current higher education is a public good through which individuals can bring benefits to the larger society, continuous improvement is needed in order to keep this mission alive (Kezar et al., 2005; Lewis & Hearn, 2003). The following research questions will be addressed in the present study:

(1) What is the relationship of student-faculty interactions and student-student interactions to graduating seniors' perceptions of their collaborative learning skills?

(2) Is the relationship of student-faculty interactions and student-student interactions to graduating seniors' perceptions of their collaborative learning skills moderated by gender?

(3) Is the relationship of student-faculty interactions and student-student interactions to graduating seniors' perceptions of their collaborative learning skills moderated by academic areas?

(4) Is the relationship of student-faculty interactions and student-student interactions to graduating seniors' perceptions of their collaborative learning skills moderated by their retrospective perceptions of their collaborative learning skills as freshmen?

Overview of Methods

For this correlational study, cross sectional data were collected through a web-based survey instrument sent to all graduating senior students at a southeastern university. The self-report survey, developed by the university's Office of Assessment and Evaluation, asked about students' demographics, their in-class and out-of-class experiences, future plans upon graduation, and perceptions of a number of core skills such as critical thinking, written

communication, oral communications, teamwork, problem solving, or other similar skills. Specifically they were asked to report their current level of competence and reflect back on their level of competence when they first entered the university.

The researcher used simultaneous multiple regression to explore the relationship of the predictive variables as they related to the dependent variable of interest. The analyses were conducted in a two-stage fashion. For the first research question, the first stage was focused on the relationship between the independent variable and the dependent variable without controlling for other variables. The second stage for the first question explored the same relationship after controlling for covariates. For the second research question, the first stage mainly examined the relationships of student-faculty interactions, student-student interactions, and gender to the outcome variable graduating seniors' perceived collaborative learning skills. In the second stage of this question the interaction effects of each independent variable with the gender introduced to the model. A similar strategy was followed to address the third question. In a first stage the variables student-faculty interactions, student-student interactions, and students' academic areas were entered as independent variables predicting the outcome variable. The second stage of this question introduced the interaction effects of both student-faculty interactions and student-student interactions with the academic area. For the last research question the variables student-faculty interactions, student-student interactions, and students' retrospective perception of their collaborative learning skills as freshmen were entered as independent variables. In the second stage of this research question, the interaction effects of both student-faculty interactions and student-student interactions with students' retrospective perception of their collaborative learning skills as freshmen were added to the model. In the following section the limitations of the current study are discussed.

Limitations

The focus of this study was on the relationship of key predictive variables on students' perception of their level of collaborative learning skills and was an examination of whether these relationships vary between male and female students or among students from hard pure, hard applied, soft pure, and soft applied academic areas. The sample for this study is composed of graduating senior students at one large southeastern university.

As is the case with other college impact studies, potential selection bias exists within the sample simply because students self-select to attend college and self-select to attend the college under focus in the present study. As such, any comparison analyses within this study may be limited to individuals who are more likely than non-college-bound peers to have high levels of collaborative learning skills, participate in groups to solve problems, and have higher levels of personal development. The scope of this study does not include comparison data on the impact of college on collaborative learning skills between college and non-college individuals. Rather, the scope of this study includes the relationship of students' interactions with faculty and with other students on their perceptions of their collaborative learning skills.

One of the independent variables was students' retrospective perceptions of their collaborative learning skills as they entered college. As a result, variation in students' perceptions of their collaborative learning skills level as they graduate from college could be more confidently attributed to variation in the independent variable measures of specific college experiences. The dependent measure, perception of collaborative learning skill, was an empirically derived and tested factor with acceptably high reliability ($\alpha = .73$). Yet, the dependent measure was limited in its capacity to capture all possible behaviors, experiences, and outcomes considered to be collaborative learning. This is primarily due to the cross-sectional

nature of this study and the use of secondary data in this analysis. The use of secondary data for this analysis also limits the extent to which the researcher could determine an equation that estimated the relationship among variables consistent with every theoretical and empirical finding within the literature.

Another limitation of the current study is that the sample utilized to examine the relationship between collegiate experiences (i.e., student-student interactions, student-faculty interactions) and a composite score of college students' collaborative learning skills comprised of students of a southeastern university. Results of the present study (the nature and magnitude of the relationship between college experiences and collaborative learning skills by gender and academic area) may not be applicable to other students or other settings. The nature and the magnitude of the relationships may change for students of other colleges and universities, leading to different results. Furthermore, the present study included analyses of self-reported data by students and did not have access to information regarding the nature of students' collaborative activities or the role they assumed. As such, the data represented an indirect measure of what students report rather than a direct measure of their skills. Future researchers may use direct measures of collaborative learning skills (e.g., observations) to evaluate student learning outcomes.

Because only about 13% of the sample consisted of persons of color, the researcher was unable to disaggregate by race. Results from the present study may be used to reflect the interrelationships of variables for White (non-Hispanic) college graduates but they may not be generalized to African American students or students of other racial/ethnical backgrounds. It might be useful to explore racial/ethnic subgroups, as it is possible that different groups within the "students of color" category are affected differently by interactions with their peer and

faculty. Although the response rate was not low with 43.9%, the response rate may pose non-trivial threats to the external validity of the study's findings. More than half of the graduating seniors have not participated in the survey which brings non-response bias to mind. To account for any potential bias in this regard, demographics of the overall graduating senior students are discussed in methods section of the present study. Although, respondents were representative of some of the variables of the seniors, the question remains unanswered how the relationships among variables of the study would have been with the inclusion of non-respondents. Thus generalization of the results of the study to their counterparts in the other half of the graduates may be limited. Consequently, cautious confidence can be placed in the validity and generalizability of these results to other seniors in the university.

In addition, the survey item asking about students' gender was a categorical variable with only two values. Students had to categorize themselves either under male or under female. Thus, this may have marginalized transgender students. Also, results are based on quantitatively collected data. Inclusion of qualitatively collected data certainly would contribute to a more comprehensive understanding of the phenomena. Elements of both qualitative and quantitative research approaches could be combined to strengthen the breadth and depth of the study results (Johnson, Onwuegbuzie, & Turner, 2007).

Organization of Dissertation Chapters

The purpose of this study was to examine the relationships between gender, academic areas (hard pure, hard applied, soft pure, and soft applied), interactions with faculty and other students, and students' perceived level of collaborative learning skills as graduating seniors and retrospective to their entering the university. To this end Chapter Two presented a literature review that explored the connections between collegiate experiences and collaborative learning

skills. Astin's (1993) input-environment-outcome college impact model served as a theoretical framework within the connections between college experiences and collaborative learning. Chapter Three provided an examination of the overall research approach, including details on the sample, dependent and independent measures, research methods, and statistical analyses that were used in the study. A detailed results section, with tables and appendices, was presented in Chapter Four. Lastly, Chapter Five provided a discussion of the overall results of this study and how they can guide future research on students' growth or development of collaborative learning. Chapter Five also included conclusions and implications these results have for policy, practice and implementation within higher education, as well as the relationship between the findings and theory, and concluded with suggestions for future research.

Chapter 2

Literature Review

Introduction

This chapter presents the theory and research literature related to the study of collaborative learning skills as an important outcome of college and its relationship to selected college experiences on student perceived collaborative learning skills (CLS). After a brief introduction, the chapter begins with a review of college impact models and an integrative analysis of several college-impact models, continues with empirical research conducted on the relationship of student and faculty interactions with college learning outcomes as well the relationship of student and student interactions with college learning outcomes. Next, the chapter includes the relationship between college environment and student characteristics such as student gender and academic areas. In addition, theory and research on the construct of collaborative learning skills and conceptualizations of why it is a valued outcome of college are presented. Furthermore, studies are presented where the relationship of the overall college experience and specific elements of the college experience to the development and promotion of students' engagement in collaborative learning during college are explored. Social cognitive theory is then introduced and examined as potentially useful concept to inform the analysis and study of graduating seniors' collaborative learning skills and some of the factors that might impact its development. A concluding section summarizes the key elements of the review and previews the forthcoming methodology chapter.

College Impact Models

The college environment is composed of a multitude of programmatic and structural characteristics that influence the growth, development, and experiences of college students. To

fully examine the degree to which these structural and programmatic elements significantly impact the effects of selected collegiate experiences on students' growth or development of *CLS*, it is necessary to control for background characteristics, precollege experiences, and college-level experiences and engagement using college impact methodology.

In this section several college impact models are presented and described. Moreover, the rationale of using one specific college impact model was stated. Studies using college impact models as a conceptual framework measure student outcomes as a function of different variables. Hence, the focus is on origins and processes through which a student changes during college (Pascarella & Terenzini, 2005). College impact models are considered to be less specific than theories of college student development and less grounded in theories of pre-college development (Pascarella & Terenzini, 2005). Researchers utilizing college impact models tend to incorporate constructs pertaining to student background characteristics (including gender, SAT scores), institutional characteristics, measures of student involvement, and indicators of college effects (Weidman, 1989). Data that have valid measures across all four conceptual frameworks allow researchers to measure the unique contribution and the cumulative effect of college experiences and provide empirical evidence of supporting or diminishing indicators of student success.

Astin's I-E-O Model

Various theoretical frameworks are proposed by researchers to study the relationship between student-faculty interaction and student educational outcomes (Astin, 1984; Pascarella, 1985a; Tinto, 1987, 1993; Weidman, 1989). However, Astin's involvement theory (1984) and I-E-O (Inputs-Environments-Outcomes) framework (1993) are especially relevant, in both a conceptual and a methodological sense, to the current study. In his involvement theory Astin

focused on behavioral mechanisms and processes that enhance student development and he argued that students learn and develop as a result of their involvement in college experiences (Astin, 1984). Moreover, Astin's I-E-O framework accounts for characteristics that vary among students and college environments and guides researchers to explore the unique predictive power of student-faculty interaction and student-student interaction on outcome measures such as collaborative learning skills when controlling for various covariates.

Astin's (1993) I-E-O model is an assessment tool to gather information and understand the relationships among variables of college learning environments. In the current study his I-E-O model was utilized to understand the interrelationships among variables such as student-student interactions, student-faculty interactions, and student characteristics. When studying these relationships, it is important to minimize the error associated with causal inferences by controlling for students' input characteristics (Astin, 1993). Astin's I-E-O model was designed to be used in nonexperimental educational studies where students cannot be randomly assigned to certain environments (Astin & Sax, 1998). The I-E-O model studies the interrelationships between educational environment (E) and student learning outcomes (O) while controlling for student inputs (I). Thus, the primary purpose of the model was to control for input variables in order to gain a better understanding of the connections between college environment and student outcomes.

The following section is a description of the three components of Astin's (I-E-O) model and what measures can be categorized under each component. Input refers to qualities students bring into college including achievement, values and attitudes (Astin, 1993). Other variables that can be categorized under inputs are sex, age, other student measures such as career choice, major field of study, and values and attitudes (Astin, 1993). These inputs both directly and indirectly

through environment influence college outcomes. The environment component of the model refers to students' college experiences: everything that happens in the classroom, outside the classroom, in peer environments and in interaction with faculty. They can be both formal and informal experiences. Some examples for variables that can be categorized under environment are curricular activities, co-curricular activities, classroom climate, living on campus, interactions with peer and faculty, and student organizations. Finally, outcomes refer to college outcomes including direct and indirect measures of learning and development. Examples include student satisfaction, measures of certain skills and abilities, GPA, and degree aspiration (Astin, 1993).

Astin's (1993) I-E-O model has been used by many researchers to evaluate relationships among student inputs, environmental factors, and student outcomes (Astin & Sax, 1998; Campbell & Blakey, 1996; House, 1999; Kelly, 1996; Kim & Sax, 2007, 2009;Knight, 1994a, 1994b; Long, 1993). Astin's (1993) input-environment-outcome (IEO) model is considered the most widely utilized and influential college impact model (Pascarella & Terenzini, 2005). The model was originally proposed in 1970, refined conceptually over the years and remained relatively unchanged. Astin's IEO model is one of the models that deal with the environmental effect on college student change. Instead of focusing on intra-individual perspective of student change these models examine sociological origins of change or growth (Pascarella & Terenzini, 2005). The model is considered the most durable and influential college impact model that serves as a guide in studying the impact of college on student change (Pascarella & Terenzini, 2005). The model consists of three elements: *inputs*, the individual and background characteristics, social and academic experiences of the student upon entry into college; *environment*, policies, cultures, faculty interactions, student interactions, formal and informal experiences that a student

is exposed to during college; and *outcomes*, student skills, abilities, values, behaviors and various measures of the student's characteristics after exposure to the college environment.

Pascarella's GMAC Model

Another college impact model that incorporates both institutional and environmental characteristics is proposed by Pascarella and it allows researchers to examine student change from a multi-institutional perspective (Pascarella, 1985a; Pascarella & Terenzini, 2005). Pascarella's General Model for Assessing Change (GMAC) consists of five sets of variables and is an extension of Astin's (1993) IEO college impact model. Similar to Astin's input measure, the first set of GMAC consists of student background characteristics and precollege traits. The second set measures the organizational and structural characteristics of the college such as selectivity of the college, institutional type, and enrollment. In the GMAC the third set captures institutional environment and is shaped by the first two sets. The fourth set measures college environment and the interactions of students with other students, faculty and/or staff. The elements in this set are considered as agents of socialization and proposed to have influence on student change. The fifth and last set explores the quality of student effort and is shaped by the previous sets within the GMAC. Pascarella's GMAC is designed to measure student change as a function of precollege measures, socializing agents, and the quality of effort a student invests in their learning.

Weidman's College Impact Model

Pascarella's GMAC (1985a) was not the first to recognize the influential benefits of the agents of socialization on college outcomes. Weidman (1989) incorporates in his college impact model various levels of social agents as a set of variable influencing student change. Similar to prior college impact models (see Astin, 1993; Pascarella, 1985b), Weidman incorporates

precollege student background characteristics and college experiences as influential mechanisms on socialization outcomes. Within the model, parental socialization and non-college reference groups receive particular attention as socialization influences. Parental socialization is comprised of student's SES, lifestyle, and relationship with their parents. Non-college reference groups refer to the relationships students have with their peers, employers, and community agents. These two types of socialization are viewed as continually influenced by a student's background and precollege characteristics. Of particular interest in Weidman' model is the importance of SES which is considered two separate locations – background characteristics and ongoing parental socialization (Padgett et al., 2010).

Weidman (1989) emphasized student interactions with peers and faculty as important agents of socialization and recognizes their influence on college outcomes. Both formal and informal social interactions are seen as parts of student's socialization process and have impact on student's behavior, skills, and values. Weidman's (1989) model was designed to explore affective outcomes (i.e., aspirations, values, and career choice) associated with socialization to college.

A good deal of empirical evidence supports the predictive validity of these good practices and recognizes the influence of these good practices on cognitive, psychosocial, and personal development in college (e.g., Astin, 1993; Cruce, Wolniak, Seifert, & Pascarella, 2006; Padgett, Johnson, & Pascarella, 2012; Pascarella & Terenzini, 1991, 2005; Sorcinelli, 1991). Yet, only a few researchers have examined how collaborative learning, as one of these good practices, is influenced by college environment. Furthermore, the magnitude of the effects of college environment on collaborative learning for different gender and academic area is almost unexplored.

Embedded within nearly all of the good practices is the application of socialization and agents of socialization. In particular, college impact research has been inundated with studies examining faculty and peer interactions. Frequent faculty and peer interactions are considered two of the primary influences on student development (e.g., Astin, 1993; Cruce et al., 2006; Kuh & Hu, 2001; Newman & Newman, 1976; Padgett et al., 2010; Pascarella & Terenzini, 1991, 2005; Tierney, Corwin, & Colyar, 2005; Whitt, Edison, Pascarella, Nora, & Terenzini, 1999b). One study in particular found student-faculty interactions to significantly contributed to student learning and personal development for all racial and ethnic groups (Lundberg & Schreiner, 2004). Upon reviewing and disseminating years of research, Astin (1993) labeled peers the "single most important environmental influence on student development" (p. xxii). College seniors reported that interactions with their peers had the greatest impact on their personal learning and development (Kuh, 1995).

Literature Review Summary

To summarize, this section presented several college impact models as assessment tools in higher education to gather information and to understand the processes taking place in college learning environments. In Astin's (1993) (I-E-O model) it is proposed that the student inputs both directly and indirectly through college environment influence college outcomes. A rationale statement for the use of the I-E-O model is provided and studies have been presented where the model was utilized. Further, other college impact models such as Pascarella's (1985a) General Model for Assessing Change (GMAC) and Weidman's (1989) college impact model were discussed. Pascarella's GMAC consists of five sets of variables and examines the interrelationship among student backsground characteristics, organizational and structural characteristics of college, institutional environment, college environment, and student effort. In

Weidman's model precollege student background characteristics and college experiences are incorporated as crucial factors influencing college students' socialization outcomes.

The following section will introduce some variables that influence college student outcomes. First empirical studies will be presented that focused on the impact of student and faculty interactions on student learning, students' personal and intellectual progress, student persistence, standardized learning outcomes, and self-reported gains. Next previous research is introduced where the influence of student and student interactions on student outcomes was studied. More specifically, studies are presented where researchers examined the relationship between student and student interactions and college outcomes such as academic and personal development, leadership skills, problem solving skills, cultural awareness, self-reported gains, and standardized measures of reading, math, and critical thinking. Further sections will discuss the relationship between college experiences and gender as well the relationship between college experience and students' academic areas. In addition, collaborative learning, a crucial college student learning outcome, is introduced and studies are presented where the relationship between college environment and collaborative learning skills are explored. Further, research is discussed where the impact of collaborative learning on college students' personal and intellectual development, interpersonal skills, and teamwork skills were studied.

Student-Faculty Interactions

When studying the impact of the college on student learning outcomes student-faculty interactions have been reported as being one of the most influential components of college environment. The current section presents various studies where the influence of student-faculty interaction was examined. In some of these studies researcher explored the relationship between student-faculty interactions and students' standardized measures to analyze the impact of those

interactions. Other researchers used self-reported gains in students' personal and intellectual development to examine the influence of student-faculty interactions.

Interacting with faculty – whether in the classroom, or outside the classroom – is one of the key college experiences associated with student learning and development. Researchers reported that positive interactions with faculty have significant impact on students' favorable educational experiences and outcomes (Lau, 2003; Pascarella & Terenzini, 1991). Interactions with faculty had positive influences on students' intellectual growth, personal development, degree aspirations, and academic achievement (Astin, 1977, 1993; Endo & Harpel, 1982; Kuh & Hu, 2001; Pascarella, 1980; Pascarella & Terenzini, 1991; Thompson, 2001; Volkwein, King, & Terenzini, 1986). Furthermore, researchers reported positive relationship between student-faculty interactions and various student outcomes such as students' intellectual growth, students' self-concept, persistence, and their contentment with non-academic life (Astin, 1993; Campbell & Campbell, 1997; Kuh, 1995; Pascarella, 1985b; Pascarella & Terenzini, 1976; Tinto, 1975).

The majority of researchers studying the relationship between student-faculty interactions and student outcomes until 1990s utilized aggregate student samples and have not studied the disaggregated student groups by gender, race or other factors (Pascarella & Terenzini, 2005). However, recent studies proposed that the effect of student-faculty interaction on student outcomes may be "conditional." Thus, the same experiences that students are exposed may have differing relationships with students' personal and intellectual development depending on student characteristics such as demographics or other variables (Pascarella, 2006). For instance, researchers reported that student-faculty interactions may differ by student gender (Colbeck, Cabrera, & Terenzini, 2001; Kezar & Moriarty, 2000) or by student race (Cole, 2004; Mayo, Murguía, & Padilla, 1995). Furthermore, Sax, Bryant, and Harper (2005) found that male

students' interactions with faculty led to greater gains in their social activism, political engagement, and liberalism when compared with female students. By contrast, female students reported that they interactions with faculty led to greater gains in their sense of physical, emotional, and academic well-being. Thus, the use of aggregated student samples cannot fully capture the relationships among variables. The conditional power of gender and race between student-faculty interactions and college outcomes makes one think about possibility of other conditional relationships in the college experience (Kim & Sax, 2007). Likewise, Pascarella (2006) argued that studying diverse student groups would enhance our understanding of the college experiences on student outcomes.

Using his I-E-O model and a composite measure of student-faculty interaction, which consisted of the items such as being a guest in a professor's home, working on a professor's research, interacting outside class, helping a professor as a teaching assistant, Astin (1993) reported that student-faculty interactions were found to be the most significant aspect of the student's undergraduate development. The positive significant relationship of the student-faculty interactions on student outcomes persisted even when entering student characteristics and other environmental variables were controlled. For instance, student-faculty interaction is reported to have a significantly positive impact on measures such as GPA, degree attainment, graduating with honors, and enrollment in graduate or professional school. In addition, student-faculty interaction had positive correlations with self-reported gains in intellectual and personal development, and diversity orientation.

The study of the relationship of student-faculty interaction with student learning conducted by Kuh and Hu (1999) is considered to be the most widespread one (Pascarella & Terenzini, 2005). In their study Kuh and Hu explored the factors underlying the College Student

Experiences Questionnaire that was completed by nearly 55,000 full-time enrolled undergraduates from 201 four-year institution between 1990 and 1997. Factor analysis was employed to examine the different types of student-faculty interactions. The analysis resulted in three types of student-faculty interactions: *substantive interaction* which consists of items asking whether students asked faculty for information related to course, made an office appointment with faculty, asked for comments-criticisms about work. The second factor extracted was *out-of-class contact,* consisting of items asking students whether they had coffee, cakes, or snacks with faculty and discussed personal problems with faculty. The last type of student-faculty interaction was defined as *writing improvement* which asked students whether they asked an instructor for advice on writing and made appointment to talk about criticism.

Student-faculty interactions outside the classroom are assumed to be important factors that influence student learning and development in undergraduate education (Kuh & Hu 1999, 2001; Pascaralle & Terenzini, 1991). However, researchers proposed that the focus of student-faculty interactions outside the classroom has a greater impact on student learning than the frequency of the interactions. Furthermore, research indicated that certain types of interactions (intellectual, substantive) influence student learning more than simple social exchange (Kuh & Hu, 1999; Pascaralle & Terenzini, 1991).

After controlling for gender, race, SES, academic major, measures of academic effort and involvement, and institutional characteristics such as selectivity and type, Kuh and Hu (1999, 2001) found that substantive interaction with faculty has positive and statistically significant effects on student self-reported gains in knowledge acquisition and academic skill development. Other types of student-faculty interactions were found to be insignificant after controlling for various confounding variables. As Kuh and Hu (2001) added elements that measure institutional

environment into their prediction equation, the effect of substantive student-faculty interaction became statistically insignificant. This was interpreted as institutional environment having a mediator role in the relationship between substantive student-faculty interaction and student learning. Thus, substantive student-faculty interaction influenced students' perceptions of institutional environment which then affected learning positively (Pascarella & Terenzini, 2005).

Despite their differing research design, student sample, and control of confounding variables, other researchers reported positive and statistically significant influences of student-faculty interactions on self-reported gains and student learning (Cabrera, Nora, Terenzini, Pascarella, & Hagedorn, 1999; Douzenis, 1996; Kuh et al., 1997; Pike, 1991; Volkwein, 1991; Volkwein & Carbone, 1994). Anaya (1999) controlled for student precollege academic ability, institutional characteristics, and demographic characteristics and found a significant impact of talking with faculty outside class and working on a faculty's research project on a standardized measure of learning: the Medical College Admissions Test. Moreover, Kuh and Hu (1999) reported similar findings when they studied the impact of students' talking with a faculty and working with a faculty member on research projects on self-reported gains in their work skills, values and ethical standards, and teamwork skills. Student-faculty interactions, where issues of student development were discussed, were found to have positive and significant impact on students' general cognitive development during college (Astin, 1993; Franklin, 1993; Frost, 1991; Ishiyama, 2002; Kitchener, Wood, & Jensen, 1999; Terenzini, Springer, Yaeger, Pascarella, & Nora, 1994; Tsui, 1999). Other researchers studying the relationship between reflective thinking and student-faculty interactions outside the class used an instrument called *Reasoning About Current Issues Test*. They found that students' interactions with faculty, where they talk about course issues, discuss career choice, personal development or work on a research

project, have significantly positive influences on students' reflective thinking (Kitchener et al., 1999). Researchers using a multi-institution sample found similar relationship between student-faculty interactions and measures of cognitive development. The results were similar for a relationship between student-faculty interaction and both standardized measures of cognitive development (Dey, 1991) and student self-reports of growth in intellectual development such as critical thinking and problem-solving skills (Astin, 1993; Franklin, 1995; Kim, 1995, 2002).

This section presented studies where researchers explored the impact of student-faculty interactions of various college outcomes. Student-faculty interaction has significantly positive relationship with students' intellectual growth, personal development, academic achievement, self-concept, satisfaction with non-academic life, self-reported gains, and overall student learning. Common in all the studies discussed previously was that the effect of student-faculty interaction remained positive and statistically significant even after the confounding variables such as precollege academic ability, student demographic characteristics, and institutional selectivity were added into the prediction equations.

Student-Student Interactions

Another factor influencing students' personal and cognitive development is student-student interactions. The present section presents a summary of studies where researchers examined the relationship between student-student interactions and numerous college outcomes. Other studies are presented where the impact of student-student interactions were explored for different college types. Moreover, the use of both standardized measures and self-reported data was discussed when examining the relationship between student-student interactions and college outcomes.

Student-student interactions have been found to be the most powerful source of influence on the undergraduate student's academic and personal development (Astin, 1993).Using a composite score of student-student interaction consisting of items such as discussing course content with other students, participating in group projects, assisting other students, participating in intramural sports, being a member of a social fraternity or sorority, participating in campus protests, and participating in student clubs, he reported that this composite score significantly impacts various college outcomes. Specifically, student-student interaction had significant positive impact on students' leadership development, self-reported gains in problem-solving skills, critical thinking skills, and cultural awareness. In addition, student-student interaction had negative impact on feeling depressed and on the beliefs that the individual cannot change society. Certain student input characteristics such as gender, race, and SES were found to be significant predictors of many student outcomes (Astin, 1993).

In studies where researchers utilized self-reported gains, positive and significant impact of peer interactions on knowledge acquisition and academic skill development has been reported (Douzenis, 1996; Smart, Feldman, & Ethington, 2000). Peer interactions positively influenced self-reported gains in intellectual development during college in both community college samples (Douzenis, 1996; Smart, Feldman, & Ethington, 2000) and four-year college samples (Astin, 1993; Cabrera et al., 1999; Volkwein & Carbone, 1994; Watson & Kuh, 1996; Whitt et al., 2006; Williams, 1990). Consistent results have been found when learning is measured by standardized tests such as the National Teachers Examination (Astin, 1993) or the verbal score on the Graduate Record Examination (Anaya, 1999). Most of the studies listed above controlled for students' level of academic effort or involvement as confounding variables and still found significantly positive relationship between students' involvement in peer interactions and their

learning. Evidence indicates there was a positive correlation between academic and social involvement. Thus students with high levels of engagement of academic experiences tended to be highly involved in nonclassroom activities/pursuits (Bryant & Bradley, 1993; Pascarella & Terenzini, 1991).

Interactions with peers outside of the classroom had a net positive impact on learning (Pascarella & Terenzini, 2005). Peer interactions, particularly those that extend and reinforce what happens in the academic program were indicated as the most influential peer interactions. Other impressionable interactions among students were those where students discussed policies and issues related to campus activities, religious, philosophical, or political beliefs, their personal problems, arts, science, technology, or international relations as well an idea brought up in class (Pascarella & Terenzini, 2005). Whitt, Edison, Pascarella, Nora, and Terenzini (1999a) used National Study of Student Learning data and a scale that measured the extent to which students were involved in many of these, and similar types of peer interactions. They examined the relationship between this nonclassroom peer interaction scale and standardized and student self-reported gains in learning by controlling for precollege ability test scores, academic motivation, demographic characteristics and family background, full- or part-time enrollment, work responsibilities, on- or off-campus residence, time spent studying, and patterns of coursework taken in five areas. Results using the nonclassroom peer interaction scale indicated this behavior had a significant positive impact on both self-reported gains in writing, thinking skills, an understanding the arts and humanities, the standardized measure of reading comprehension, and a standardized measure of composite learning consisting of reading, mathematics, and critical thinking.

Peer interactions play a key role in learning activities. As students interacted with each other, they received immediate feedback from peers that they could reflect upon, incorporated others' perspectives into their own thinking, and became better aware of (mis)understandings by being questioned and prompted to explain their ideas (Chi, 2000; Chi, de Leeuw, Chiu, & LaVancher, 1994; Coleman, 1998; King, 1994, 1999; Kneser & Ploetzner, 2001). Moreover, discussion with a peer provided opportunities for students to ask questions of each other, to challenge one another, to catch and correct their own mistakes, and to compare their conceptual understandings with their peers (Andriessen, Baker, & Suthers, 2003; Asterhan & Schwarz, 2009, 2010; Hausmann, Nokes, VanLehn, & Van de Sande, 2009). As they interacted with each other, students not only acquired knowledge but also developed skills and abilities such as co-constructing ideas or solutions to problems, sharing knowledge, correcting one another's conceptual misunderstandings, elaborating on their understanding of the phenomena (Hausmann, 2006; Roschelle, 1992; Teasley & Roschelle, 1993).

This section presented studies where researchers explored the relationship of student-student interactions with various college outcomes. Student-student interaction has significantly positive relationship with college outcomes such as students' knowledge acquisition, academic skill development, and gains in intellectual development. In studies discussed previously, the positive impact of student-student interaction persists both for community college students and four-year college students.

Research on the Relationship of College Experiences with Gender

In this section studies are presented where researchers examined the nature and magnitude of the relationship between college environment and learning outcomes by student gender. Studies are also included where researchers examined the relationship between college

experience and various college outcomes by gender such as critical thinking, intellectual development, reading comprehension, personal development, standardized math, and science reasoning.

Numerous researchers studied the effect of a "chilly climate" (gender inequity) on female students' learning and development in college and proposed that gender inequity had a negative impact on women's intellectual and personal development (Allen & Niss, 1990; Boyer, 1987; Hall & Sandler, 1982, 1984; Holland & Eisenhart, 1990; Sandler, Silverberg, & Hall, 1996). Researchers conducted observations in classrooms to explore the chilly climate and its consequences on students' development (Brady & Eisler, 1996; Cornelius, Gray, & Constantinople, 1990; Fassinger, 1995; Williams, 1990), and examined whether women's perceptions of gender inequity in an institution's environment impede their learning (Hagedorn, Siadat, Nora, & Pascarella, 1997; Pascarella et al., 1997; Whitt, Edison, Pascarella, Nora, & Terenzini, 1999b).

Other researchers assessing gender inequity utilized a composite score of items asking whether female students were singled out in class for their gender, being treated differently by faculty, and/or observed prejudice against women by other students. Results of these studies indicated that women's perceptions of gender inequity within the institutional environment had significant impact on students' learning in college (Pascarella & Terenzini, 2005). Although few researchers found a small, positive influence of institutional gender inequity on reading comprehension for women at four-year colleges (Whitt et al., 1999a), other researchers reported a negative impact of women's perceptions of gender inequity in college settings. Perceptions of gender inequity had a significantly negative impact on standardized measure of learning consisting of reading, mathematics, and critical thinking for two-year college women when

precollege academic ability, the type of coursework taken, and other measures of academic and social involvement were statistically controlled (Pascarella et al., 1997). When a standardized measure of mathematics skills was utilized, the negative impact of gender inequity persisted for women at both two- and four-year colleges (Hagedorn et al., 1997). Other researchers found a negative influence of gender inequity on self-reported gains in writing and thinking skills, understanding science, and understanding the arts and humanities for women at both two- and four-year colleges (Whitt et al., 1999a).

In their study Whitt et al. (2006) defined gender inequity as the average responses on the gender inequity climate scale by the sample of women at a number of institutions and analyzed its impact on female students' learning and development. These researchers reported a positive impact of gender inequity scale on women's gains on a standardized measure of mathematics skills (Whitt et al., 2006). The positive impact persisted when various factors such as student's precollege academic ability, extensive measures of a student's academic and social effort and involvement, and other measures of the aggregate institutional environment are statistically controlled (Whitt et al., 2006).

Researchers studying the relationship between college experiences and critical thinking reported that the net effects of college on critical thinking vary by student gender. Further, evidence suggested that the direction of this relationship vary for students in community colleges versus four-year colleges (Whitt et al., 2006). It is reported that women in community colleges have statistically significant disadvantage in the first-year critical thinking gains relative to men (Whitt et al., 2006) when variables such as precollege critical thinking level, academic motivation, socioeconomic status, sex, institutional selectivity, total credit hours completed, study effort, patterns of coursework taken, work responsibilities, and extensive measures of

academic and social involvement were statistically controlled. However, women in four-year institutions demonstrated statistically significant advantage in their critical thinking at the end of three years over men (Whitt et al., 2006).

After their analyses of the multi-institutional 1986 to 1990 Cooperative Institutional Research Program data, Smith, Morrison, and Wolf (1994) defined college experience as a "gendered experience" (p. 696) and proposed that women and men will vary in the way they experience the college and its impact on their learning and development. This conclusion was supported by various researchers (Flowers, Osterlind, Pascarella, & Pierson, 2001; Whitt et al., 2006). Flowers et al. examined the magnitude of the impact of college on men and women using the 56-insitution, cross-sectional College Basic Academic Subjects Examination (CBASE) data set. They defined the impact of college as the difference between freshmen and seniors on the four CBASE score: English, mathematics, science, and social studies. They found that the magnitude of the freshman-senior difference was significantly larger for men on all four tests after controlling individual ACT scores, race, college grades, number of credit hours completed, and the average ACT score of students at the institution attended.

Moreover, Whitt et al. (2006) used the National Study of Student Learning data and examined the college impact on students' standardized measure of end-of-first-year mathematics knowledge. They reported that compared with men women in both two- and four-year colleges had significantly lower scores on this standardized measure. Similarly, they reported that women in four-year colleges had significantly lower score on a standardized measure of science reasoning after two year of college (Whitt et al., 2006). Consistent results were reported in case of statistical controls of patterns of course-work taken in mathematics and science, precollege test scores, academic motivation, student demographic characteristics, the academic selectivity

of the institution attended, credit hours completed in college, and extensive measures of academic effort and social involvement during college (Whitt et al., 2006). Further evidence indicated that women report smaller learning in the areas of science reasoning and mathematics than men and that this difference persisted even with statistical controls for patterns of coursework taken (Pascarella & Terenzini, 2005).

Researchers reported a similar impact of college on male and female students' level of identity development and locus of control (Pascarella & Terenzini, 2005). However, women demonstrated slightly more gains in self-esteem than men and greater gains in a standardized measure of their writing skills after two years in college when the factors of coursework taken in mathematics and science, precollege test scores, academic motivation, student demographic characteristics, the academic selectivity of the institution attended, credit hours completed in college, and extensive measures of academic effort and social involvement during college were controlled (Whitt et al., 2006). Furthermore, women grow more than men in self-esteem from earning an advanced degree (Pascarella & Terenzini, 2005). Other college experiences seem to have a similar impact on both male and female college students' development and attitudes. For example, researchers reported that living on campus, participating in racial-cultural awareness workshops, taking diversity courses, working, joining a fraternity or sorority, and interacting with peers appeared to have about the same net impact on women's and men's openness to diversity (Pascarella & Terenzini, 2005).

Researchers reported that engaging in some in-class and out-of-class activities have different impact on male and female students' learning. For instance, engagement in volunteer work during college and involvement in course-work in the natural sciences and humanities had stronger positive impact on male students' reading comprehension, general cognitive

development (i.e., critical thinking) than the of the female students (Pascarella & Terenzini, 2005). On the other hand, female students involved in sororities reported greater gains in critical thinking than male students engaged in fraternity clubs. Furthermore, researchers indicated greater cognitive development (i.e., reflective thinking, critical thinking) of female students from working and living experiences on campus. Female students also derived greater economic return from a bachelor's degree in engineering, mathematics, or the physical sciences, as well as from good undergraduate grades, irrespective of their major (Pascarella & Terenzini, 2005). Similarly, female students majoring in mathematics and science reported greater first- to senior-year increases in math self-concepts than do male students. Male students majoring in disciplines where interpersonal skills, friendliness, helping others, and sensitivity to others reported greater gains in cognitive development than do men majoring in other fields. However, women in these "social" fields, showed no greater increases in such skills than do women who major in other discipline areas (Pascarella & Terenzini, 2005).

Astin (1993) argues that the college does not eliminate or reduce stereotypical differences between the sexes although students are exposed to a common college environment. Further, it is proposed that the differences of male and female student in their level of emotional and psychological health, standardized test scores, and personality are not reduced or eliminated by the college education. Instead the stereotypical differences between male and female students are strengthened.

This section summarized studies where researchers examined the relationship between college experience and college outcomes by gender. Studies are presented where the impact of gender inequity on college outcomes was explored. While some of the researchers reported as negative impact of gender inequity on female students' learning development, others propose

that gender inequity positively influences female students' standardized measure of math skills. Further, it is discussed that the impact of college experiences on students' cognitive development such as science reasoning and critical thinking vary by gender. In addition, studies are presented where researchers used multi-institutional data to examine the college impact on students' standardized measures of English, math, and social science. Overall, the impact of college experiences on college students' learning outcomes varies by student gender.

Research on the Relationship of College Experiences with Academic Area

Another student characteristic that impact the nature and magnitude of the relationship between college experience and learning outcomes is academic area. In this section studies are presented where researchers examined the nature and magnitude of the relationship between college environment and learning outcomes by academic areas. Studies where researchers reported varying relationship between college environment and students' academic self-concept, cognitive development, personal development, psychosocial growth are going to be discussed.

Some researchers studying the impact of college experiences on student learning and cognitive development reported net differences due to academic major (Smart, Feldman, & Ethington, 2000; Whitmire & Lawrence, 1996), whereas others do not (Li, Long, & Simpson, 1998, 1999). Significant differences were reported in reasoning and metacognitive skills among students of different academic majors (Zhang & RiCharde, 1998). Moreover, majoring in the natural sciences, mathematics, or technical fields were reported to have positive effects on students' academic self-concept (Pascarella & Terenzini, 2005).

Researchers studying the impact of academic major on students' persistence reported that, students majoring in the sciences, mathematics, and engineering and/or business and health-related professions were more likely to persist and earn bachelor's degrees than their peers with

majors in the social sciences, humanities, or education (Adelman, 1998; DesJardins, Kim, & Rzonca, 2002-2003; Fenske, Porter, & DuBrock, 2000; Leppel, 2001). Other researchers reported significant impact of academic major on standardized measure of student learning. For instance, analyzing the 1985 to 1989 CIRP data, Astin (1993) and Anaya (1992, 1996) found that majoring in physical science, engineering, and technical fields had small positive effects on GRE quantitative scores. Utilizing the same data and controlling for academic ability and other confounding influences, Astin (1993) found that majoring in education negatively influenced the general knowledge score on the National Teachers Examination (NTE) but positively influenced the NTE professional knowledge score.

Although students majoring in certain academic areas were reported to have significant advantages in their intellectual development and learning, Pascarella and Terenzini (2005) conclude that there was little evidence of a differentiating effect of academic major on student critical thinking skills. Furthermore, they reported that the inconsistent findings of researchers on this relationship are results of the use of different operational definitions of academic major. Pascarella and Terenzini (2005) argue that different disciplines attract different kinds of students and then highlight the initial differences among students across those various disciplines. For instance, students in academic majors where economic gain, goal achievement, and leadership abilities are stressed show greater gains in those areas than students majoring in other disciplines where those are not emphasized.

Pascarella and Terenzini (2005) argue that little evidence support that academic major has a different impact on students' psychosocial growth, attitudes, or values. They defined the effects of academic major as a function of the values and traits of the students choosing a discipline rather than the traits of that discipline's specific content. For instance, majoring in

engineering and business had positive net effects on women's math self-concepts, and majoring in women's studies contributes to identity development in women. Furthermore, majoring in business, nursing, science, or engineering was associated with smaller increases in positive racial-cultural attitudes and openness to diversity compared with other academic majors (Pascarella & Terenzini, 2005). After analyzing numerous studies Pascarella and Terenzini concluded that the effect of academic major on students' development and learning depends on (1) the economic opportunities associated with an academic major and (2) the culture and climate within a department which refers to the quality of student-faculty interactions, how much faculty support students, and student' interaction with their peer, faculty values, to what extent faculty is accessible to students.

Furthermore, Pascarella and Terenzini (2005) argue that the interpersonal relations and valuing homogeneity within a department are more influential on students' cognitive development and changes in attitudes when compared with the effects of structural characteristics of a discipline. Likewise, factors such as faculty supportiveness, frequency of student-faculty interaction and peer interactions had a greater impact on student persistence regardless of the department and academic major. Other researchers studying the factors influencing student persistence supported this hypothesis. Both within and across the science, mathematics, and engineering disciplines, student persistence was influenced significantly by factors such as classroom climate and practices, attitudes, values and culture in these disciplines (Seymour & Hewitt, 1997), students' interactions with their peer and the number of peers in different majors (Astin & Astin, 1993; Takahira, Goodings, & Byrnes, 1998), student characteristics and the general college environment (Sax, 1996), and students' contentment with their major and its educational climate (Hilton, Hsia, Solorzano, & Penton, 1989).

Research on Collaborative Learning

In this section the rationale of studying the relationship between college environment and collaborative learning skills is presented and the definition of collaborative learning as well as its importance in college learning environments are discussed. Various studies are presented where researchers examined the impact of collaborative learning on other college outcomes such as social and cognitive development, knowledge sharing, gains in interpersonal skills, and promoting team work skills.

The choice of collaborative learning skills as a dependent variable is important for various questions raised in the literature. First, collaborative learning was identified as one of the seven engagement indicators predicted to directly influence the quality of students' educational experiences and learning (Chickering & Gamson, 1987). As students are involved in problem based learning methods and engaged in team projects, their problem-solving skills, creative thinking, and application of knowledge in real-world contexts were promoted (Barron et al., 1998).

Researchers studied the relationship between collaborative learning and students' learning and intellectual development (critical thinking skills, productivity) in various settings. The impact of collaborative learning activities persisted in classroom and laboratory, in face-to-face as well as computer-mediated settings (Johnson & Johnson, 1992, 2009; Johnson et al., 1991). Collaborative work within or outside classroom benefited students, enabled them to learn from each other as they work on a project. Thus, collaboration enhanced their learning outcomes beyond what they were capable of by working alone (Chi, Roy, & Hausmann, 2008; Shirouzu, Miyake, & Masukawa, 2002).

Knowledge is acquired through social interactions with others. Collaborative learning is one type of learning practice where student interact with their peers, asks questions, and learn from each other. In a collaborative learning environment information and concepts are not transmitted from expert to novice; instead, they are learned as individuals are engaged in group interactions. Knowledge is constructed by group members as they actively engage in social activities (Pascarella & Terenzini, 2005). In collaborative learning environments, students work in groups consisting of their peers towards specific knowledge acquisition or skill development and this makes them act relatively independent of an instructor (Cohen, 1994; Dillenbourg, 1999). A major purpose of collaborative learning is to promote college students' social interactions and cognitive development (Webb, 1989; Webb & Palincsar, 1996). In collaborative learning environments, students discuss about and elaborate on their knowledge, ideas and their beliefs (O'Donnell & King, 1999; Palinscar & Brown, 1984; Rosenshine & Meister, 1994). Thus, learners work to co-construct knowledge collaboratively (Fischer, Bruhn, Gräsel , & Mandl, 2003; Roschelle & Teasley, 1995).

As the work place becomes more and more knowledge-based it is hardly possible for an individual to succeed in given tasks without help of others (Barron, 2000). Therefore, collaborative learning gains more importance in today's work place and need to be promoted in school settings to enable a smooth transition of students from the school to work place (Chai & Tan, 2009). Individuals bring their own unique knowledge and possibly divergent perspectives into a collaborative learning environment. Collaborative learning is the process where these divergent perspectives and different aspects of information move to collaborative knowledge building. Social interaction among group members enables this shared knowledge building. Thus collaborative learning is a social process where individuals adopt various strategies for resolving

differences, create new understandings based on the discussion that they have had, and construct knowledge (Chai & Tan, 2009). Overall, collaborative learning help students to integrate various perspectives and understanding of the domain into a broader shared knowledge and to apply it in other situations (Chai & Tan, 2009).

Overall, this section has presented numerous studies of the impact of college environment variables such as student and faculty interactions and student and student interactions on college students' personal and intellectual development as well as on standardized and self-reported gains. Further, the relationships of student characteristics such as gender, and academic areas with college experiences were introduced. Last, the impact of collaborative learning on college students' personal and intellectual development, team work skills, and interpersonal skills was explored.

Following section will introduce the conceptual framework of the present study and discuss from which perspective college learning was considered throughout the study. After an introduction where social cognitive learning theory is introduced, the researcher summarizes important aspects of social cognitive theory in regard to human learning. It will be discussed how social cognitivists study human social behavior and to what extent college learning environments can be studied from social cognitivist perspective.

Conceptual Framework

In this section conceptual framework of the study is going to be presented which would help the reader to better understand the dynamics among the variables that are studied in this dissertation. Social cognitive theory will be described to gain a comprehensive understanding of the relationship between college environment and college outcomes. More specifically, the

interrelationships among student characteristics, college experiences and college outcomes will be the explored in the light of social cognitive learning theory.

Social cognitive theorists study what and how people learn from one another by emphasizing observational learning and modeling. It is proposed that people can learn by observing the behaviors of others, as well as by observing the outcomes of those behaviors. Thus, most learning takes place through watching the behavior of other individuals/models. Further, they argue that consequences of behavior play a role in learning. Such learning by observation and modeling is the focus of social cognitive theory (e.g., Bandura, 1977, 1986; Schunk, 1992; Zimmerman, 2006).

This section is focused on social cognitive theory's perspective of the environmental and cognitive factors interactions and how this influences human learning and behavior. The effect of modeling in learning, its effects on behavior, and the characteristics of effective models are discussed. Eventually, possible implications of social cognitive theory for educational practices will be presented.

Cognition is the mental process where people acquire, retrieve, store, manipulate, and utilize information (Reitman, 1965; Shuell, 1986). Thus, it can be considered as human information processes (Zimmerman & Kitsantas, 2005) and interpreted as a nonsocial term which exclusively happens in the human mind (Larson & Christensen, 1993). However, cognition is influenced and determined by elements that are fundamentally social (Allard-Poesi, 1998; Levine & Resnick, 1993), and, therefore, its conceptualizing as an intraindividual process would be too narrow (Levine & Resnick, 1993).

Socially distributed cognition refers to the process where individuals share and integrate their knowledge for more effective task management (Cicourel, 1990; Patel, Kaufman, &

Arocha, 1995). Zusho, Pintrich, and Coppola (2003) define social cognition as the interplay of cognition and social behavior. Martin and Clark (1990) considers social cognition as an approach to understanding human social behavior by investigating the mental processes of people interaction with each other. Further social cognition is defined as a social process where information is acquired, retrieved, transmitted, and manipulated in order to promote group learning (Larson & Christensen, 1993). Socio-cognitive processes are the patterns of thinking, feeling, and acting (Hofstede & Hofstede, 2005, p. 3) related to human interaction. Social-cognitive activities include acquisition, dissemination, implementation of information and discarding old information (e.g., Audi, 1998; Fiske & Taylor, 1991). They also involve storing information and skills, manipulating memory, processing information, and sense making (Goldman, 1986; Pentland, 1995; Posner, 1996).

Social cognitivists study human social behavior by examining the mental processes of people interacting with one another (Martin & Clark, 1990). Specifically, social cognition is the process of trying to understand the aspects of human information-processing within social interactions including what it influences, and how it is influenced by other factors (Gioia & Sims, 1986). As such, social cognition goes beyond the cognitive approach (which focuses on individual cognitive processes) and emphasizes organizational and group routines (Gherardi, 1998; Schwarz, 1995) as well as integrates different views on the process of learning (such as behaviorism, cognition, and social construction (Akgun, Lynn, & Byrne, 2003). In this vein, the socio-cognitive perspective of organizational learning approaches the learning process via reciprocal relations of both cognitive processes and social constructs. Collaborative learning is one example of organizational learning where students interact with each other and exchange both information and attitudes (Vygotsky, 1978).

Social-cognitive learning theory is focused on human functioning as reciprocal interactions between behaviors, environmental variables, and cognitions and other personal factors. In this approach, individuals' behavior is explained by environmental, personal, and behavioral interactions (Bandura, 1986). It is argued that environment can influence both the person and the behaviors. In fact, each of these three variables (environment, person, and behavior) influences the other two in a reciprocal fashion (Bandura, 1989). Certainly the environment influences a person's behavior, but the perceptions of the environment (a "person" variable) have also an effect on behavior (Ormrod, 2004). Thus, not only environment influences behavior but also mental processes happening within individuals affect behavior. Likewise, behavior affects both the environment and the personal characteristics that they develop (Ormrod, 2004). In the sociocognitive approach to learning, person variables and environmental variables affect each other. This happens as the responses people make (e.g., choice of coursework, out-of-class activities, choice of peer) determine the situations they find themselves in and the consequences they experience (environmental variables).

Social cognitive theory is focused on students as active seekers and processors of information (Bandura, 1986; Pintrich, Cross, Kozma, & McKeachie, 1986) and focuses on the ways in which individuals learn from observing one another. The process where individuals learn by observing each other is called modeling (Bandura, 1986). Most of the human behavior including academic skills and attitudes are learned through modeling (Ormrod, 2004). Environmental factors such as reinforcement and punishment play a crucial role when individuals learn by observation. Socio-cognitivists argue that people are either reinforced or punished for modeling the behaviors of others and that reinforced behavior will be repeated whereas punished one will be terminated (Ormrod, 2004).

Social cognitive theorists propose that the impact of the environment decreases over time as individuals begin to regulate their own behavior. Self-regulation is defined as individual's ability to regulate her actions (Bandura, 2004; Glanz, Lewis, & Rimer, 1990). Self-regulation is a process which involves problem solving, decision making as well as goal setting (Bandura, 1997, 2004). And individuals regulate their own behavior by developing their own standards for performance and observing and judging themselves based on these standards (Ormrod, 2004). Further individuals regulating own behavior reinforce or punish themselves for what they have and not have done. Thus the process of self-regulation helps the individual to be less and less influenced by the environments they encounter (Bandura, 2002).

Socio-cognitive theory has many implications for educational practices. Students often learn and acquire new skills by observing others. Further, they develop new attitudes by modeling which finally enable them to regulate their own behavior based on their own standards. Thus modeling can be utilized in educational settings when teaching a new concept or a behavior (Ormrod, 2004). Likewise, group activities can be integrated into coursework where students can collaborate on assignments and eventually develop a high collective self-efficacy. As students participate in such in-class and out-of-class activities social exchanges are enabled. And these social exchanges help students to share knowledge, norms, attitudes, and produce shared cognitive products (Gruenfeld & Hollingshead, 1993; Levine & Resnick, 1993). Researchers indicate that social climate of a group influences group members' ability to exchange and integrate information. Further they suggest that the more frequent social interactions happen among group members the higher is the chance of the group to succeed (Argote, Ingram, Levine, & Moreland, 2000; Argote & Ingram, 2000; Kogut & Zander, 1992).

Summary

The purpose of this study was to examine the relationships between gender, academic areas (hard pure, hard applied, soft pure, and soft applied), interactions with faculty and with other students, and students' perceived level of collaborative learning skills as graduating seniors and retrospective to their entering the university. Various studies are presented where the relationship between many aspects of college environment such as student-student interactions, student-faculty interactions and learning outcomes was explored. In addition, the impact of student gender and academic areas on the nature and magnitude of this relationship was discussed.

To guide the study's investigation of the effects of college experiences on students' development of collaborative learning skills, social cognitive learning theory is used as a conceptual framework. Within its conceptualization, collaborative learning can be viewed as a cognitive process which is strengthened through social interactions. In other words, individuals who exhibit high level of social interactions enhance their collaborative learning skills. This study addresses this conceptualization and gaps in the literature by investigating the effects of student gender and academic areas on student development of collaborative learning skills. The next chapter presents the detailed methodological plans and analytical techniques to be used to estimate the effects of student-student and student-faculty interactions on collaborative learning skills.

Chapter 3

Methods

Introduction

The purpose of this study was to examine the relationships between gender, academic areas (hard pure, hard applied, soft pure, and soft applied), interactions with faculty and with other students, and students' perceived level of collaborative learning skills as graduating seniors and retrospective to their entering the university. Four research questions served as a guide for this study:

(1) What is the relationship of student-faculty interactions and student-student interactions to graduating seniors' perceptions of their collaborative learning skills?

(2) Is the relationship of student-faculty interactions and student-student interactions to graduating seniors' perceptions of their collaborative learning skills moderated by gender?

(3) Is the relationship of student-faculty interactions and student-student interactions to graduating seniors' perceptions of their collaborative learning skills moderated by academic area?

(4) Is the relationship of student-faculty interactions and student-student interactions to graduating seniors' perceptions collaborative learning skills moderated by their retrospective perceptions of their collaborative learning skills as freshmen?

These questions were examined using institutional survey data collected by the university's Office of Assessment and Evaluation which included responses from about 1800 senior students. The sections of this chapter introduce the research methods and survey design, including student sample and data collection. The next sections include a description of the

factor scale of the dependent measure – seniors' perceptions of collaborative learning skills – and the independent measures that were used in this study. The following section continues with a detailed description of the analyses for this study, including an examination of the statistical procedures that are utilized to address threats to standard linear models, analysis of missing data, and analytical limitations of this study. Finally, a summary of the methodology of this study and organization of the document are presented.

Instrument

A 40-item web-based survey was developed by the Office of Assessment and Evaluation staff and administered in early spring 2013 to all graduating senior students at a large southeastern university in the United States. The purpose of the survey, approved by the university's institutional review board (IRB), was to gather information regarding students' perceptions of their collegiate experiences as they related to teaching and learning in their major and across the university. Survey items were derived from the literature and from faculty input; the survey was pilot-tested and reviewed by a panel of evaluation specialists and graduate students in Educational Research and Evaluation.

Two survey items of interest in this study asked for students' perceptions of their beginning collegiate skill levels in twelve different areas: "Below are skills and abilities that a graduating senior, regardless of major, might possess. Please indicate the level of proficiency you believe you had when you entered the university". The other asked for students' perceptions of their current skill levels: "Below are skills and abilities that a graduating senior, regardless of major, might possess. Please indicate your current level of proficiency." These items were designed to provide a cross-sectional method to evaluate perceived longitudinal gains in twelve core areas: written communication skills, oral communication skills, critical thinking/analysis,

computer/technology skills, interpersonal (social) skills, leadership skills, organizational ability, ability to work in teams to solve problems, ethical reasoning, ability to work across disciplines, knowledge of global issues, and ability to communicate with people different from yourself. Students were asked to respond to each of the twelve items for their beginning collegiate skill level and their current skill level on a four-point scale: (1) "very low," (2) "low," (3) "average," and (4) "above average."

Another item of interest on the survey was the student's major. For this item, students were provided with a drop down menu of all undergraduate majors at the university. Students were asked to indicate their primary major (for those with double or triple majors, they were only allowed to choose what they considered to be their "primary" major). Responses to this item were used to categorize respondents in this study by one of four academic areas – hard pure, hard applied, soft pure, and soft applied. Biglan's (1973) classic framework was used to classify the different academic areas. Hard versus soft refers to the degree to which a paradigm exists and pure versus applied refers to the degree of concern with application. More specifically, hard pure academic areas (i.e., mathematics, biology, chemistry) are natural sciences and they are "concerned with universals, quantities, and simplification". The purpose of hard pure academic areas is to discover and explain (Becher, 1994, p. 154). Hard applied academic areas are science based professions and these academic areas are classified as being "pragmatic and concerned with mastery of physical environment" The purpose is often to produce and develop techniques. Soft pure academic areas are Humanities and Social sciences and are classified to be "concerned with particulars and qualities". The purpose of soft pure disciplines is to understand and to interpret. The last category soft applied refers to professions that are based on social sciences. This type of disciplines is identified as being "concerned with enhancement of professional

practice." The purpose of soft applied disciplines is to "result in protocols/procedures." (Becher, 1994, p. 154). These categories were developed based on Biglan's (1973) classification of the academic areas. According to this classification disciplines such as Aerospace Engineering, Chemical Engineering, Civil Engineering, and Biological Systems Engineering were divided under hard applied academic areas. Physics, Chemistry, Biochemistry, and Biological Sciences were classified as hard pure academic areas. History, Philosophy, Psychology, and Political Sciences were considered as soft pure disciplines and finally International Studies, Architecture, Economics, and Accounting and Information Systems were classified as soft applied disciplines. Please see Appendix A for a complete list of disciplines divided into the four academic areas. Respondents were also asked to identify their gender: male or female. This survey was included as a link in a solicitation email sent to all undergraduates intending to graduate that semester. Two subsequent email reminders were sent to non-respondents.

Sample

The web-based survey was distributed to 4,218 senior students at a southeastern university. 1,852 senior students responded, resulting in a response rate of 43.9%. The sample consisted of 854 female (46.1%) and 826 (44.6%) male students. One hundred and seventy-two (9.3) students did not report their gender. Of the 1,852 students, 41 students (2.2%) were African American, 95 (5.1%) were Asian/Pacific Islander, 47 (2.5%) Hispanic/Latino, two (.1%) Native American, 1378 (74.4%) White (non-Hispanic), 54 (2.9%) Multi-racial, and 68 (3.6%) others. Among these students 167 (9.0%) have not reported their race. The sample consisted of 513 students (27.4%) in soft pure academic areas, 451 (24.1%) in soft applied academic areas, 436 (23.3%) in hard pure academic areas, and 452 (25.2%) in hard applied academic areas. Following section will present the dependent variable that was examined in this study.

Dependent Measure

Collaborative learning skills, referred to as CLS in this study, are student skills necessary for successful collaborative learning. To determine which of the twelve skill areas constitute CLS an exploratory factor analysis (EFA) was conducted to construct this outcome measure (Sahbaz, Culver, & Burge, 2014). A principal-component factor analysis was performed using the survey item which asked students about their proficiency level in twelve skills and abilities as they graduate from college and yielded sound goodness-of-fit indexes. Only items with factor loadings of .50 or greater were eligible for inclusion in the factor solution. The scale reliability coefficient (i.e., Cronbach's alpha) was then assessed to identify the strength of the factor solution. Based on the student sample, the internal consistency reliability for the scale was .73. According to the results of the EFA (Sahbaz et al., 2014) the construct CLS consisted of the following skills: oral communication skills, interpersonal/social skills, leadership skills, and students' ability to communicate with people different from themselves.

The composite score derived from respondents' self-reported proficiency level on these four skills and abilities (oral communication skills, interpersonal/social skills, leadership skills and their ability to communicate with people different from themselves) were used as the dependent measure in the current study. Students were asked to rate their proficiency on each of the four items on (1) "very low", (2) "low", (3) "average", and (4) "above average". Consequently, composite score ranged from a low of 4 ("very low" on all four skills) to 16 ("above average" on all four skills).

Independent Measures

Student gender was the first input variable in the regression equation. Student gender was a dichotomous variable for which a value of 1 indicated a male student and a 0 indicated a

female student. Another input variable was academic area: hard pure, hard applied, soft pure, and soft applied. Since this variable was categorical, the researcher utilized dummy coding to include it in the regression model. For analysis purpose, academic area was recoded into d1 (1 if in hard applied academic areas, 0 otherwise), d2 (1 if in hard pure academic areas, 0 otherwise), and d3 (1 if in soft pure academic areas, 0 otherwise). The third input variable was the retrospective score of students' perceptions of their collaborative learning skills as freshmen. This variable was constructed in the same manner as the dependent variable, using a parallel survey item that asked students to reflect back to the time they entered the university and rate their proficiency level of their skills. Scores on this variable ranged from a low of 4 ("very low" on each of the four CLS items) to 16 ("above average" on each of the four CLS items). According to the reliability analysis, this construct had a Cronbach's alpha of .72 indicating an internally consistent construct (Nunnally, 1978).

Another independent measure in the study was a composite score of student-faculty interaction. This score was derived from responses to four items asking respondents to indicate their level of student-faculty interactions. Specifically, the questions asked, "Please rate each of the following for your primary major: (1) quality of in-class student-faculty interaction, (2) quality of out-of class student-faculty interaction, (3) instructors' concern for students, and (4) faculty accessibility outside class." Possible responses for each of these items were: 1=not applicable, 2=unacceptable, 3=slightly unacceptable, 4=slightly acceptable and 5=acceptable. Not applicable responses were omitted and the remaining response categories recoded 1-4 for each item. The composite score then ranged from a low of 4 ("unacceptable" on all four items to a high of 16 ("acceptable" on all four items). The scale reliability coefficient (i.e., Cronbach's alpha) for this sample was .79.

Another independent measure in the study was student-student interactions. This measure was represented by five items that asked respondents to indicate to what extent they had opportunities to learn from their peer, whether they participated in different student organizations and asked respondents to "Please rate each of the following for your primary major: Opportunities to learn from other students. Possible responses for this item were: 1=not applicable, 2=unacceptable, 3=slightly unacceptable, 4=slightly acceptable, and 5=acceptable. Those who indicated "not applicable" were omitted from the analyses. Remaining responses were recoded into a dichotomous format. Those indicating "unacceptable" or "slightly unacceptable" were coded as 0; those who responded "slightly acceptable" or "acceptable" were coded as 1. The other four dichotomous items were from a list asking students whether or not they had participated in certain student organizations: (1) Organizations or clubs designed for people in my primary major, (2) social fraternity or sorority, (3) student government, and (4) other student organizations. Students responded that (1) they had participated in the activity or (0) they had not participated in the activity. Scale scores on this measure of student-student interaction ranged from a low of 0 (no participation, unacceptable learning from other students in their major) to a high of 5 (participation in all four student organizations and acceptable learning form students in their major. Although the reliability coefficient for this construct was not high with .30, the construct was used because of the lack of alternative survey items to capture the extent to which student interact with other students. The issue with the internal consistency of this construct was addressed in discussion section of this study.

Analyses

The researcher used ordinary least square regression (OLS) to estimate the relationship of the student-student and student-faculty interactions on the perceptions of collaborative learning

skills of male vs. female students and students of different academic areas (i.e., hard pure, hard applied, soft pure, and soft applied). When using a standard linear model for a method of analysis, six assumptions must be satisfied to validate how the dependent measure is estimated from the values of the independent measures (Allison, 1999; Osborne & Waters, 2002). These six assumptions include the following: 1) The variables are normally distributed, 2) The dependent measure is a linear function of the independent measures, 3)The measures used for the regression analysis are measured without error, 4) Homogeneity of variance (Homoscedasticity), 5) Residuals are normally distributed, and 6) Residuals are independent meaning that the value of the error term in one case is uncorrelated with the value of the error term for any other case (Allison, 1999; Osborne & Waters, 2002). When these assumptions are satisfied, the performance of the OLS produces unbiased estimates and efficient coefficients. Non-normally distributed variables that are highly skewed or kurtotic would cause a misinterpretation of the relationships and significance tests (Osborne &Waters, 2002). The linear nature of the relationship between dependent and independent variables enabled the researcher to correctly estimate the true relationship among the variables (Osborne &Waters, 2002). Reliably measured constructs are crucial in a multiple regression analysis to get correct estimate of the relationships among variables in the population (Osborne & Waters, 2002). To this end, a Cronbach alpha of .7-.8 was acceptable (Nunnally, 1978). In case of heterogeneity of the variance the results of the analysis are distorted and the errors are increased (Tabachnick & Fidell, 1996).

Because the researcher estimated CLS across a fully specified model, there was a possibility that some multicollinearity exists across the independent measures. To investigate the presence of multicollinearity, a variance inflation factor (VIF) test was conducted for each independent variable. If the VIF scores fell within an acceptable range, this suggested that there

was limited and nonproblematic multicollinearity between the independent measures (Allison, 1999; Myers, 1990; Stevens, 2002).

All the above listed assumptions were tested before conducting the multiple regression analyses. To test the normality of the variables P-P-plots were used (Osborne & Waters, 2002) and the variables were all identified as being normally distributed by the software SPSS v. 20. The linearity of the relationship between the dependent variable and the independent variables was tested by plotting standardized residuals as a function of standardized predicted values (Berry & Feldman, 1985; Cohen & Cohen, 1983; Pedhazur, 1997). The relationship between the dependent variable and the independent variables was identified as being linear. To examine if the variables were measured without error reliability analyses have been conducted. The Cronbach's alpha coefficient for the constructs student-faculty interactions, graduating seniors' perceived collaborative learning skills, students' retrospective score of collaborative learning skills were all above .7 and thus internally consistent. To test the assumption of homoscedasticity the plot of the standardized residuals (the errors) by the regression standardized predicted value was examined (Osborne & Waters, 2002). Because the residuals were randomly scattered around 0, the assumption of homoscedasticity was met. To test the assumption if the residuals were normally distributed the P-P-plot of the residuals was examined. The curve representing the expected cumulative probability and the curve of observed cumulative probability overlapped significantly. Thus, the residuals were considered as being normally distributed. In addition, to test the assumption if the residuals were independent, the Durbin-Watson coefficient was used. Based on the output the Durbin-Watson coefficient was close to 2 indicating an independence of the residuals (Chatterjee & Hadi, 2012). The presence of multicollinearity was examined using the variance inflation factor. Based on results the VIF scores ranged between 1.00 and 1.6,

indicating that multicollinearity was not an issue for the multiple regression analyses in this study.

The regression analyses were carried out in two steps. The first step of the analyses was used to determine if there was a relationship of student-student interaction and student-faculty interaction scales with students' perceptions of their collaborative learning skills. The CLS composite score was regressed on the student-student interaction and student-faculty interaction plus all the control variables (i.e., student gender, academic area, a retrospective score of collaborative learning skills). A series of equations were created to estimate these relationships. For equation one the variable students' collaborative learning skills was regressed on student-faculty interactions and student-student interactions. This allowed student-student interaction and student-faculty interaction to account for as much variation in students' collaborative learning skills as possible. The second equation estimated the relationship of student-student interaction and student-faculty interaction to the dependent variable while statistically controlling for students' gender. The third equation estimated the relationship of student-student interaction and student-faculty interaction while controlling for gender and students' academic area. And the last equation estimated the same relationship while controlling for gender, academic area and students' retrospective score of their perceived collaborative learning skills.

The second stage of the analyses was designed to ascertain if the relationship of student-student interaction and student-faculty interaction on collaborative learning skills were conditional on student's gender, academic area, or retrospective score of collaborative learning skills. The researcher created cross-product terms, multiplying student-faculty interaction and student-student interaction with student gender, academic area, and their retrospective score of collaborative learning skills, respectively. These cross-product terms were then added to the

general effects model. A statistically significant increase in explained variance (R^2), over and above the general effects model, indicated significant relationships, which were further examined. The next section contains a discussion of missing at random or systematic and how missing data was treated.

Missing Data

A number of missing data analysis techniques were conducted to deal with both item non-response and unit non-response. To investigate unit non-response bias in this study a comparison of two demographic variables was made to explore their representativeness of the whole senior student population graduating the same year (N=4,218). Based on the demographics about half of the respondents were female students (46.1%). This proportion seemed to represent the whole population because female students make up about the half of the population (50.5%). When the ethnicity measure was considered, the situation was similar. The sample of the senior students (n=1,852) included in the study consisted of 41 African American students (2.2%) , 95 Asian/Pacific Islander (5.1%), 47 Hispanic/Latino (2.5%), 2 Native American (.1%), 1378 White (non-Hispanic), (74.4%), 54 Multi-racial (2.9%), and 68 (3.6%) others. The proportions for the whole senior student population were the following: African American 2.4%, Asian/Pacific Islander 7.3%, Hispanic 4.0%, Native American .2%, White 82.5%, and Multi-racial 3.6%. A chi-square test was conducted to examine whether percentages of each ethnic group in the sample represented the percentages of the whole senior student population. With a χ^2 value of 2.22 ($p<.05$), there was not a significant difference between the expected percentages and the observed percentages of each ethnic group. Thus, the sample represents the whole senior population at the university.

Before dealing with item non-response bias it was first explored if the missing data were completely at random. Missing completely at random (MCAR) refers to the fact that missing data in independent variables are not related to the value of the dependent variable. If the missing is not completely at random, the regression estimates might be biased (Allison, 2002). To explore if the missing was completely at random, Little's test (Little, 1988) was utilized. Based on the results of the Little's test, missing data were missing completely at random, thus there was no systematic difference between those participants who had complete data and those participants who had missing data. After exploring that the missing was random, expectation maximization (EM) method was used to replace the missing data (Dempster, Laird, & Rubin, 1977).

Summary

Using an institutional sample data, multiple regression was utilized to examine how graduating students' perceptions of their collaborative learning skills level was affected by their interactions with faculty as well as with other students. In addition, an examination of whether graduating seniors' perceived collaborative learning skills were related to gender, academic area, and students' retrospective score of their perceived collaborative learning skills as freshmen was completed. This analysis incorporated both theoretically and empirically supported independent measures such as student characteristics and selected measures of college experiences to estimate students' perceived collaborative learning skills. In Chapter Four, a detailed presentation and analysis of the results are provided.

Chapter 4

Results

Introduction

The purpose of this study was to examine the relationships between gender, academic areas (hard pure, hard applied, soft pure, and soft applied), interactions with faculty and with other students, and students' perceived level of collaborative learning skills as graduating seniors and retrospective to their entering the university. The study was focused on the following research questions:

(1) What is the relationship of student-faculty interactions and student-student interactions to graduating seniors' perceptions of their collaborative learning skills?

(2) Is the relationship of student-faculty interactions and student-student interactions to graduating seniors' perceptions of their collaborative learning skills moderated by gender?

(3) Is the relationship of student-faculty interactions and student-student interactions to graduating seniors' perceptions of their collaborative learning skills moderated by academic area?

(4) Is the relationship of student-faculty interactions and student-student interactions to graduating seniors' perceptions of their collaborative learning skills moderated by their retrospective perceptions of their collaborative learning skills as freshmen?

To explore these questions, simultaneous multiple regression was used to investigate the relationships among the variables included in the study. The use of multiple regression provided the ability to examine the effect of several predictor variables on the outcome variable. This statistical procedure also allowed estimation of the net contribution of each independent variable

and blocks of independent variables on the dependent variable. The net effects of each independent variable on the dependent variable are stated in general terms (without any control of other independent variables). Interaction effects were also explored. More specifically, student-student interactions (*StSt*) and student-faculty interactions (*StFac*) were investigated to examine if these differentially affected senior students' perceptions of their collaborative learning skills (*CLS*) with different input variables (i.e., gender (*Gender*), academic area (*AcAr*), which consists of four categories (i.e., *Hard Applied, Hard Pure, Soft Pure, Soft Applied*) and student's perceived level of collaborative learning skill as a freshman (*RetroCLS*).

In the present study relationships among the variables of interest were examined and the presentation of results was organized by research questions. For the first research question, the two independent variables *StSt* and *StFac* were regressed on the dependent variable, graduating seniors' perceived collaborative learning skills (*CLS*). Results here focused on: (1) whether the model overall is significant, (2) how much of the variance in the outcome variable is explained by the combination of the two independent variables, and (3) the nature and magnitude of the relationship of each independent variable with the outcome variable. In addition, the study examined whether controlling for three additional independent variables, gender, academic area, and retrospective perception of the student's collaborative learning skills as a freshman, affected the overall model. To this end, the independent variables (*Gender, Hard Pure, Hard Applied, Soft Pure,* and *RetroCLS*) were added to the model in addition to the previous variables, *StSt* and *StFac*. It was then examined to what extent the relationship between student-student interaction and the outcome variable as well the relationship between student-faculty interaction and the outcome variable were changed. Thus, the relationship of the two independent variables, student-student interactions and student-faculty interactions, to graduating seniors' perceived

collaborative learning skills was examined after controlling for students' retrospective perceived collaborative learning skills, their academic areas, and their gender.

For the second question, student-student interactions, student-faculty interaction, and an additional independent variable, gender, were regressed on graduating seniors' perceived collaborative learning skills. Similar to the first research question, it was first examined if the model was a significant one, how much of the variance in the outcome was explained by the model, and the nature and magnitude of the relationship between each independent variable (i.e., student-student interaction, student-faculty interaction, and gender) and the outcome variable. In addition, the interaction effect between *StSt* and *Gender* as well as the interaction effect between *StFac* and *Gender* were added to the model. These interaction effects were used to explore if the relationship of *StSt* and *StFac* and to the outcome variable *CLS* was moderated by students' gender. The same procedure was applied to the independent variables *Hard Applied, Hard Pure, Soft Pure,* and retrospective perception of collaborative learning skills as a freshman (*RetroCLS*) to answer research questions 3 and 4.

Sample

Survey respondents are characterized in Table 1, according to gender, race/ethnicity, academic area, and current GPA. As shown in Table 1, 854 (46.1%) female and 826 (44.6%) male graduating students participated in the survey, 172 did not report gender. The majority (n=1378, 74.4%) of the survey participants were White (non-Hispanic); 41 (2.2%) were African American; 95 (5.1%), Asian/Pacific Islander; 47 (2.5%) Hispanic/Latino; 2 (.1%) Native American; and 54 (2.9%) Multi-racial. A small number of students (8, 0.4%) did not categorize themselves under any of the race/ethnicity groups provided and 60 (3.6%) students preferred not

to identify their race/ethnicity. The rest, 167 (9.0%), did not provide any indication of the race/ethnicity.

Based on their identification of major, respondents were categorized into four academic areas according to Biglan's (1973) framework. The largest group (n=513, 27.4%) of students were enrolled in soft pure disciplines, such as English, sociology, and psychology. Other students were enrolled in hard applied academic areas (25.2%), such as aerospace engineering, chemical engineering, and mechanical engineering; soft applied areas (24.1%), such as economics, architecture, and management; and hard pure academic areas (23.3%), such as agriculture, chemistry, and mathematics. The other demographic variable of interest was students' current GPA, self-reported by respondents. The largest group (n=687, 37.1%) reported a GPA of 3.01-3.50, 38.3% reported 2.51-3.00; and 6.4% between 2.01-2.50. A small number of students (n = 6, 0.3%) reported a GPA of less than 2.00. The rest, 166 (9.0%), did not provide their current GPA.

Table 1

Respondent Demographics (n = 1852)

Variable	N	%
Gender		
Female	854	46.1
Male	826	44.6
Missing	172	9.3
Race/Ethnicity		
African American	41	2.2
Asian/Pacific Islander	95	5.1
Hispanic/Latino	47	2.5
Native American	2	.1
White (non-Hispanic)	1378	74.4
Multi-racial	54	2.9
None of the above categories	8	.4
Prefer not to answer	60	3.2
Missing	167	9.0
Academic Areas*		
Hard applied	452	25.2

Hard pure	436	23.3
Soft applied	451	24.1
Soft pure	513	27.4
Current GPA		
< 2.00	6	.3
2.01-2.50	119	6.4
2.51-3.00	350	18.9
3.01-3.50	687	37.1
3.51-4.00	524	28.3
Missing	166	9.0

Note. *****refers to academic areas as classified by Biglan (1973).

Variables

The present study was designed to examine the relationships among several independent variables and one outcome variable. The outcome variable was a latent variable consisting of four indicators measuring graduating seniors' perceived collaborative learning skills. Latent variables used as independent variabes were: student-student interactions, student-faculty interactions, and students' retrospective perception of their collaborative learning skills. The present study included scales derived from the results of an exploratory factor analysis (Sahbaz et al., 2014). Table 2 presents indicators for each latent variable used in the study as well as a description of each indicator. The latent variables *CLS, RetroCLS,* and *StFac*, consisted of four indicators, whereas the latent variable *StSt* consisted of five indicators related to student participation in campus activities.

Table 2

Categorization of the Manifest Indicators under Latent Variables

Latent Variable	Wording and response pattern
CLS	Please indicate your current level of oral communication skills. (1=*very low* to 4=*above average*) Please indicate your current level of interpersonal/social skills. (1=*very low* to 4=*above average*) Please indicate your current level of leadership skills. (1=*very low* to 4=*above average*)

	Please indicate your current level of ability to communicate with people different from yourself. (1=*very low* to 4=*above average*)
StFac	Please rate the quality of in-class student-faculty interaction. (1=*not applicable* to 5= *acceptable*) Please rate the quality of out-of-class student-faculty interaction. (1=*not applicable* to 5= *acceptable*) Please rate instructor's concern for students. (1=*not applicable* to 5= *acceptable*) Please rate faculty accessibility outside class. (1=*not applicable* to 5= *acceptable*)
StSt	Please rate opportunities to learn from other students. (1=*not applicable* to 5=*acceptable*) Please indicate if you have participated in organizations or clubs designed for people in your primary major. (0=*not participated* to 1=*participated*) Please indicate if you have participated in social fraternity or sorority. (0=*not participated* to 1=*participated*) Please indicate if you have participated in student government. (0=*not participated* to 1=*participated*) Please indicate if you have participated in other student organizations. (0=*not participated* to 1=*participated*)
RetroCLS	Please indicate the proficiency level of oral communication skills you believe you had when you entered the college. (1=*very low* to 4=*above average*) Please indicate the proficiency level of interpersonal/social skills you believe you had when you entered the college. (1=*very low* to 4=*above average*) Please indicate the proficiency level of leadership skills you believe you had when you entered the college. (1=*very low* to 4=*above average*) Please indicate the proficiency level of ability to communicate with people different from yourself you believe you had when you entered the college. (1=*very low* to 4=*above average*)

Note 1. *CLS*=graduating seniors' perceived collaborative learning skills, *StFac*=student-faculty interactions, *StSt*=student-student interactions, *RetroCLS*=students' retrospective perception of their collaborative learning skills.
Note 2. For the variables *StFac* and *StSt*, not applicable responses were omitted from the analyses and the remaining response categories of these two variables were recoded 1-4 for each item.

Univariate and Bivariate Analyses

Table 3 provides the descriptive statistics for each of the variables in the equation, including the mean, standard deviation, minimum, and maximum for each of the four variables.

Also shown are the means and standard deviations for *StSt*, *StFac*, *CLS*, and *RetroCLS* within each of the academic areas and for women and men. Students reported a mean of 7.50 (SD=0.67) as their participation in student organizations (*StSt*). Given that the maximum score possible for this composite score was 8, the participants seem to be actively engaged in student-student interactions (*StSt*). In regard to student-faculty interactions, students reported a mean of 4.85 (SD=0.95) out of 11 possible points. Participants reported a relatively high perceived *CLS*, with a mean of 14.30 (SD=1.50), and a high retrospective perception of their collaborative learning skills (*RetroCLS*) as freshmen, with a mean of 12.12 (SD=1.97), out of a possible 16 points.

The means of the variables varied across the four academic areas. For example, students in hard applied academic areas reported a slightly higher mean in student-student interactions with 7.60 (SD=0.62) than other academic areas. Students in hard applied academic areas reported a mean of 4.90 (SD=1.11) in student-faculty interactions. The range of the scores were very narrow, between 4.83 (SD=0.91) and 4.84 (SD=0.95) for other groups of students, with soft pure academic areas reporting the lowest score and hard applied academic areas the highest score. For *CLS*, students reported a mean that ranged between 13.99 (SD=1.76) and 14.46 (SD=1.38), with students of hard pure academic areas reporting the lowest mean and soft pure academic areas reporting the highest mean. The situation changed slightly for *RetroCLS*. Again, students in hard pure academic areas reported the lowest mean with 11.94 (SD=2.20) along with students in hard applied academic areas with 11.94 (SD=1.97). Students in soft applied academic areas reported the highest mean in *RetroCLS*, with a mean of 12.30 (SD=2.03).

The last part of the univariate analyses explored how students' mean scores differed based on their gender. Mean scores of male and female students in terms of their student-student interactions were the same, students of both genders reported a mean score of 7.50. The standard

deviation for this score was .73 for female students and .70 for male students. In regard to student-faculty interactions, male students reported a slightly higher mean score of 4.88 (SD=1.04) whereas female students reported a mean score of 4.82 (SD=0.94). Male students seemed to perceive their *CLS* as slightly lower than female students. They reported a mean score of 14.24 (SD=1.67) whereas female students reported a mean score of 14.33 (SD=1.57). The situation remained similar for the last variable. Male students reported a mean score of 11.93 (SD=2.20) for *RetroCLS,* whereas female students reported a higher mean of *RetroCLS* with 12.31 (SD=2.05).

Table 3

Univariate Analysis of the Variables CLS, StFac, StSt, RetroCLS, AcAr and Gender

	Total			Hard Applied n=452	Hard Pure n=436	Soft Applied n=451	Soft Pure n=513	Female Students n=854	Male Students n=826
	Mean (SD)	Min	Max	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
CLS	14.30 (1.50)	4.00	16.00	14.16 (1.56)	13.99 (1.76)	14.45 (1.46)	14.46 (1.38)	14.33 (1.57)	14.24 (1.67)
StFac	4.85 (.95)	4.00	11.00	4.90 (1.11)	4.84 (.95)	4.84 (.97)	4.83 (.91)	4.82 (.94)	4.88 (1.04)
StSt	7.50 (.67)	5.00	8.00	7.60 (.62)	7.48 (.72)	7.50 (.71)	7.42 (.72)	7.50 (.73)	7.50 (.70)
RetroCLS	12.12 (1.97)	4.00	16.00	11.94 (1.97)	11.94 (2.20)	12.30 (2.03)	12.25 (1.94)	12.31 (2.05)	11.93 (2.20)

Note. Sample sizes vary from 1680 for students' gender to 1852 for academic area. *CLS*=graduating seniors' perceived collaborative learning skills, *StFac*=student-faculty interactions, *StSt*=student-student interactions, *RetroCLS*=students' retrospective perception of their collaborative learning skills, *AcAr*=students' academic area consisting of four categories of hard applied, hard pure, soft applied, and soft pure.

Table 4 presents the correlation matrix for the variables of interest. Before the regression analyses were conducted examination of how the independent variables were correlated ($p < .05$) with the dependent variable and how independent variables were correlated among each other

was conducted. As shown in Table 4, the outcome variable of graduating seniors' perceived collaborative learning skills (*CLS*) was significantly correlated with student-faculty interactions (*StFac*) ($\rho = -.05$), student-student interactions (*StSt*) ($\rho = .13$), students' retrospective perception of their collaborative learning skills as freshmen (*RetroCLS*) ($\rho = .53$) , students' being in a hard pure academic area ($\rho = -.11$), soft applied academic area ($\rho = .08$), and soft pure academic area ($\rho = .06$). The variables that were not significantly correlated with the outcome variable were students' being in a hard applied academic area and students' gender. The variable student-faculty interactions was significantly correlated with student-student interactions ($\rho = -.25$). No other variable was significantly correlated with student-faculty interactions. Furthermore, the variable student-student interactions was significantly correlated with students' retrospective perception of their collaborative learning skills as freshmen ($\rho = .06$), students' being in a soft pure academic area ($\rho = -.07$), and with students' gender ($\rho = .01$). In addition, the variable students' retrospective perception of their collaborative learning skills as freshmen was significantly correlated with students' being in hard applied academic area ($\rho = -.05$), students' being in a hard pure academic area ($\rho = -.05$), with students' being in soft applied academic area ($\rho = .07$), and with students' gender ($\rho = -.08$). Further, being a student in hard applied academic areas was significantly correlated with their being in a hard pure academic area ($\rho = -.33$), soft applied academic area ($\rho = -.32$), soft pure academic area ($\rho = -.35$) and with students' gender ($\rho = .30$). The variable students' being in a hard pure academic area was significantly correlated only with students' being in a soft applied academic area ($\rho = -.31$), being a student in soft pure academic area ($\rho = -.34$), and students' gender ($\rho = -.09$). Finally students' being in a soft pure academic area was found to be significantly correlated with students' gender ($\rho = -.20$). In addition to the variables utilized in the regression models, GPA

was examined in terms of its correlation with the variables of the interest in this study. GPA is significantly correlated with soft applied academic area ($\rho = -.06$), with hard pure academic area ($\rho = .07$), and students' gender ($\rho = -.05$). Given the sample size, an alpha level of .05 was used to denote statistical significance in this study (Schlotzhauer, 2007).

Table 4

Correlation Matrix of the Variables of Interest (n= 1852)

	1	2	3	4	5	6	7	8	9	10
1. *CLS*	-									
2. *StFac*	-.05*	-								
3. *StSt*	.13*	-.25*	-							
4. *RetroCLS*	.53*	-.02	.06*	-						
5. *Hard Applied*	-.03	.03	.08	-.05*	-					
6. *Hard Pure*	-.11*	-.01	-.01	-.05*	-.33*	-				
7. *Soft Applied*	.08*	-.01	.01	.07*	-.32*	-.31*	-			
8. *Soft Pure*	.06*	-.01	-.07*	.04	-.35*	-.34*	-.34*	-		
9. *Gender*	-.02	.02	.01*	-.08*	.30*	-.09*	-.01	-.20*	-	
10. *GPA*	.01	.01	.02	-.00	.03	.07*	-.06*	-.03	-.05*	-

*Note.** refers to p<.05. *CLS*=graduating seniors' perceived collaborative learning skills, *StFac*=student-faculty interactions, *StSt*=student-student interactions, *RetroCLS*=students' retrospective perception of their collaborative learning skills.

Regression Analyses

In this section the results of the simultaneous regression analyses are presented. Each research question was addressed in two parts. Parameters such as R^2, F-value, and the significance level of each independent variable are presented along with the direction and magnitude of the relationship of each independent variable with the outcome variable. Unstandardized regression coefficients were utilized to interpret the results throughout the study.

Research Question 1

For the first part of research question one, the variables student-faculty interaction (*StFac*) and student-student interactions (*StSt*) were regressed on the dependent variable, graduating seniors' perceived *CLS*. The output of this analysis demonstrated whether the model

overall was a significant one, how much variance in the outcome *CLS* variable was explained by the combination of the variables *StFac* and *StSt*, and if each of these two independent variables were significantly related to *CLS*. The equation was used for the first part of the Research Question 1 was formulated the following way:

$$\widehat{CLS}_i = \hat{\beta}_0 + \hat{\beta}_1 StFac_i + \hat{\beta}_2 StSt_i + e_i$$

In this equation, the population parameters for graduating seniors' perceived collaborative learning skills were estimated using student-faculty and student-student interactions as predictors. The residual e_i is the difference between the value of the dependent variable predicted by the model $\widehat{CLS}_i$ and the true value of the dependent variable CLS_i. The subscript i refers to a specific student and each student's score is estimated individually. The roof on top of the parameters refers that these are estimations gained from a sample out of a population. Overall, the equation estimates CLS of i-th student using i-th student's *StFac* and *StSt* scores.

The results, shown in Table 5, indicated that the combination of student-faculty interactions and student-student interactions was significant, $F = 18.48$, $p < .01$. However, a very small percentage of the variance in the outcome variable, graduating seniors' perceived collaborative learning skills, was explained by the combination of these two predictors, $(R^2 = .018)$. The variable that significantly contributed to the explained variance in graduating seniors' perceived collaborative learning skills was student-student interactions with $\beta = .19$ and $p < .01$. Results of this analysis indicated that the relationship between student-student interactions and the outcome variable was positive. The relationship between student-faculty interactions and graduating seniors' perceived collaborative learning skills was insignificant.

For the second part of research question one, all the other independent variables of the study were added to the analysis to examine the relationship between the variable *StFac* and the outcome variable *CLS* as well as the relationship between *StSt* and the outcome variable when the researcher controlled for all the other variables of interest in this study. Models in the first and second part of the question were compared to each other based on the percentage of the variance in the outcome explained by the model. These results are presented in Table 5.

The second part of the first research question can be shown by the following equation:

$$\widehat{CLS}_i = \hat{\beta}_0 + \beta_1 StFac_i + \hat{\beta}_2 StSt_i + \hat{\beta}_3 Gender_i + \hat{\beta}_4 HardApplied_i + \hat{\beta}_5 HardPure_i + \hat{\beta}_6 Soft\ Pure_i + \hat{\beta}_7 RetroCLS_i + e_i$$

With this equation, graduating senior students' perceived collaborative learning skill was estimated using a combination of the variables such as their interactions with faculty, interactions with other students, their gender, academic areas, and their retrospective perceived collaborative learning skills.

In the second part of this analysis the researcher examined the relationship among student-student interactions, student-faculty interactions and the outcome variable after controlling for students' retrospective measure of their perceived collaborative learning skills, their academic area, and their gender. Results indicated that the model was significant with $F = 98.08$, $p < .01$ with 29% of the variance in the outcome variable explained by the combination of independent variables. In addition, the relation between student-student interactions and graduating students' perceived collaborative learning skills was still significantly positive with $\beta = .22$ and $p < .01$. And the relationship between student-faculty

interactions and *CLS* was insignificant even after the other variables in the model were controlled.

Table 5

Effects of the Variables StFac and StSt on CLS

	Unstand. β	Stand. Error	Stand. β	Sig. α	R^2	F	Sig. α
Research Question 1							
Part I							
Model					.018	18.48	.00
Student-Faculty Interactions (*StFac*)	-.04	.03	-.03	.21			
Student-Student Interactions (*StSt*)	.19	.04	.12	.00			
Part II							
Model					.290	98.08	.00
Student-Faculty Interactions (*StFac*)	-.03	.03	-.02	.31			
Student-Student Interactions (*StSt*)	.22	.05	.10	.00			
Hard Applied (*Hard Applied*)	-.17	.10	-.04	.09			
Hard Pure (*Hard Pure*)	-.31	.10	-.08	.00			
Soft Pure (*Soft Pure*)	.10	.10	.03	.27			
RetroCLS (*RetroCLS*)	.39	.02	.52	.00			
Gender (*Gender*)	.11	.07	.03	.10			

Note. Sample sizes vary from 1680 for students' gender to 1852 for academic area. *CLS*=graduating seniors' perceived collaborative learning skills, *StFac*=student-faculty interactions, *StSt*=student-student interactions, *RetroCLS*=students' retrospective perception of their collaborative learning skills.

Overall, both of the two models significantly predicted the outcome variable, graduating seniors' perceived collaborative learning skills. However, the first model explained only about 2% of the variance in the outcome variable. The second model explained a higher percentage of the variance in students' perceived collaborative learning skills, 29%. The R^2 increased from .018 to .290 as the rest of the variables in the study were added to the model. The nature of the relationship between student-student interaction and the outcome variable remained positive and the relationship between student-faculty interactions and the outcome still was insignificant after controlling for the covariates. In the following section, the researcher explored if the relationship

of student-student interaction and student-faculty interaction with the outcome variable was moderated by students' gender.

Research Question 2

Research Question 2 addressed whether the relationship between student-faculty interactions and student-student interactions to graduating seniors' perceptions of their collaborative learning skills was moderated by gender. This question was addressed in two parts. In the first part the variable *Gender* was added to the model as a predictor in addition to *StSt* and *StFac*. The examination was focused on to what extent the combination of these three variables could predict the outcome variable *CLS*. Furthermore, the nature and the magnitude of the relationship of each independent variable with the dependent variable were examined. To this end, variables *StFac*, *StSt*, and *Gender* were added simultaneously to the model and the results were interpreted. The reference group for the variable *Gender* was female students. In the second part of this analysis, the interaction effect between *StFac* and *Gender* as well as the interaction effect between *StSt* and *Gender* were added to the model. This helped the researcher to explore if the relationships were moderated by students' gender. In the present study, the terms moderation effect and interaction effect were used as synonyms. The equation was used for the first part of the Research Question 2 was formulated the following way:

$$\widehat{CLS}_i = \hat{\beta}_0 + \hat{\beta}_1 StFac_i + \hat{\beta}_2 StSt_i + \hat{\beta}_3 Gender_i + e_i$$

The results, shown in Table 6, of the first part indicated that the combination of the independent variables *StFac*, *StSt*, and *Gender* as a whole had statistically significant predictive capability with $F = 10.64$, $p < .01$. The model had $R^2 = .020$, meaning that it explained 2% of the variance in graduating seniors' perceived collaborative learning skills. Results showed that the relationships between *StSt* and the outcome variable was significant with $\beta = .28$ and

$p < .01$. In addition the relationship between *StFac* and the outcome as well as the relationship between *Gender* and the outcome were insignificant.

In the second part of the analysis, in addition to the three independent variables that were added to the model, interaction effects between *StFac* and *Gender* as well as between *StSt* and *Gender* were added. The interaction effects helped the researcher to answer the following question: Does the effect of the first variable on the outcome variable depend on the second variable? In other words, in this part of the analysis the researcher was more interested in the effect of student-student interactions or student-faculty interactions on graduating seniors' perceived collaborative learning skills depended on students' gender. The second part of the second research question is summarized by the following equation:

$$\widehat{CLS}_i = \hat{\beta}_0 + \beta_1 StFac_i + \hat{\beta}_2 StSt_i + \hat{\beta}_3 Gender_i + \hat{\beta}_4 (StFac_i * Gender_i) + \hat{\beta}_5 (StSt_i * Gender_i) + e_i$$

With this equation, graduating senior students' perceived collaborative learning skill was estimated using a combination of the variables such as their interactions with faculty, interactions with other students, their gender, as well as the interaction effect of student-faculty interactions and student-student interactions with students' gender.

Based on the results, the model consisting of three independent variables and the interaction effects significantly predicted the outcome variable with $F = 8.86$, $p < .01$ and explained about 3% of the variance in the outcome variable. According to the results, the interaction effect between *StFac* and *Gender* as well as the relationship between *StSt* and *Gender* were statistically significant with $\beta = -.07$ and $\beta = 1.18$, respectively. The negative interaction effect between *StFac* and *Gender* meant that, the slope of student-faculty interactions and the outcome variable for male students was was weaker than the one for female students. And this

coefficient being significant meant that the difference in the slopes was statistically significant. Further, the positive interaction effect between *StSt* and *Gender* meant that, the slope of student-student interactions and the outcome variable was greater for male students when compared to the one for female students. Again, the difference in the slopes was statistically significant.

Overall, the analysis revealed that the nature and magnitude of the relationship between student-student interactions and the outcome variable remained the same in first and second part of the analysis. However, adding interaction effects to the model changed the relationship between students' gender and students' perceived collaborative learning skills from being insignificant in the first part to being significant in the second part. The model in both parts had statistically significant predictive capability and explained not more than 3% of the variance in graduating seniors' collaborative learning skills.

Table 6

Effects of the Variables StFac, StSt, Gender, and their Interaction Effects on CLS

	Unstand. β	Stand. Error	Stand. β	Sig. A	R^2	F	Sig. α
Research Question 2							
Part I							
Model					.020	10.64	.00
Student-Faculty Interactions (*StFac*)	-.04	.04	-.03	.28			
Student-Student Interactions (*StSt*)	.28	.06	.12	.00			
Gender (*Gender*)	-.09	.08	-.03	.23			
Part II							
Model					.026	8.86	.00
Student-Faculty Interactions (*StFac*)	-.01	.04	-.01	.72			
Student-Student Interactions (*StSt*)	.29	.06	.13	.00			
Gender (*Gender*)	-4.70	1.85	-1.44	.01			
*StFac*Gender*	-.07	.03	-.08	.01			
*StSt*Gender*	1.18	.46	1.46	.01			

Note. Sample sizes vary from 1680 for students' gender to 1852 for academic area.
CLS=graduating seniors' perceived collaborative learning skills, *StFac*=student-faculty interactions, *StSt*=student-student interactions.

In sum, controlling for the interaction effects influenced the nature and the magnitude of the relationship between *Gender* and *CLS*. Furthermore, the interaction effect between *StFac* and *Gender* as well as between *StSt* and *Gender* were significant. The negative interaction effect between *StFac* and *Gender* means that for male students the effect of *StFac* on the outcome was higher. And the positive interaction effect between *StSt* and *Gender* means that for male students the effect of *StSt* on the outcome variable was greater compared to female students. Thus, student-student interactions and student-faculty interactions have different impact on male and female students' perceived collaborative learning skills. The relationship of student-student interactions and student-faculty interactions with the outcome variable was moderated by students' gender.

Research Question 3

This section of the study addressed the question of whether the relationship between student-student interactions with the outcome as well as the relationship between student-faculty interactions and the outcome were moderated by students' academic area (i.e., *Hard Applied, Hard Pure, Soft Pure, Soft Applied*). A very similar procedure was used in the previous research question. In the first part of the analysis, the independent variables *StFac, StSt* and *Hard Applied, Hard Pure,* and *Soft Pure* were entered into the model to explore the relationships among these variables. The academic area *Soft Applied* was used as reference group to which other results were compared. In the second part of the regression analysis the interaction effects between *StFac* and *Hard Applied*, between *StFac* and *Hard Pure* and between *StFac* and *Soft Pure* were added to the model. In addition, the interaction effects between *StSt* and the academic areas were added to the analysis in order to explore if the relationships were moderated by students' academic area. The first part of the analysis helped the researcher to examine the relationships

among variables without controlling for the interaction effects. And the second part informed not only about how the nature and magnitude of the relationships among the variables of interest would change after controlling for the interaction effects, but also if the results were moderated by students' academic areas. The equation used for the first part of Research Question 3 was formulated as follows:

$$\widehat{CLS}_i = \hat{\beta}_0 + \hat{\beta}_1 StFac_i + \hat{\beta}_2 StSt_i + \hat{\beta}_3 HardApplied_i + \hat{\beta}_4 HardPure_i + \hat{\beta}_5 Soft\ Pure_i + e_i$$

The results of the first part indicated that the relationship between student-student interactions and graduating seniors' perceived collaborative learning skills was significant with $\beta = .29$, $p < .01$. And the relationship between student-faculty interactions and the outcome variable was insignificant. The results indicated that compare to students in soft applied academic areas, being in a student in hard applied academic areas had a significantly negative effect on student's perceived collaborative learning skills ($\beta = -.31$). Similarly, being a student in hard pure academic area had a significant negative effect on students' perceived collaborative learning skills ($\beta = -.45$). In addition, compared to being in a soft applied academic area, being in a soft pure academic area had insignificant effect on the outcome variable. Thus, compared to students in soft applied academic areas, being in hard applied or being in hard pure academic areas significantly decreased students' perceived collaborative learning skills. The model as a whole was significant in predicting students' perceived collaborative learning skills with $F = 13.19$, $p < .01$. Further the model has a $R^2 = .034$ meaning that the combination of the independent variables explained just over 3% of the variance in the outcome variable. The second part of this research question can be summarized by the following equation:

$$\widehat{CLS}_i = \hat{\beta}_0 + \beta_1 StFac_i + \hat{\beta}_2 StSt_i + \hat{\beta}_3 HardApplied_i + \hat{\beta}_4 HardPure_i + \hat{\beta}_5 Soft\ Pure_i + \hat{\beta}_6 (StFac_i * HardApplied_i) + \hat{\beta}_7 (StFac_i * HardPure_i) + \hat{\beta}_8 (StFac_i * SoftPure_i) + \hat{\beta}_9 (StSt_i * HardApplied_i) + \hat{\beta}_{10} (StSt_i * HardPure_i) + \hat{\beta}_{11} (StSt_i * SoftPure_i) + e_i$$

With this equation, graduating senior students' perceived collaborative learning skill was estimated using a combination of the variables student-faculty interactions, student-student interactions, different academic areas as well as the interaction effects between these variables. Further, it was explored if the relationships of student-faculty interactions and student-student interactions with the outcome variable were moderated by students' being in a hard applied, hard pure, or soft pure academic areas.

The results of the second part of the analysis revealed that the model significantly predicts the outcome variable with a $F = 7.42$, $p < .01$. The inclusion of the interaction effects between different academic areas and student-student interactions as well as the interaction effects between academic areas and student-faculty interactions provided further insight into the relationships among variables. According to the results, the interaction effect between *StFac* and *Hard Pure* was significant with $\beta = -.10$. Similarly, the interaction effects between *StSt* and the different academic areas were examined. According to the results, the interaction effect between *StSt* and *Hard Pure* was significant with $\beta = 1.23$. However, the interaction effect between *StSt* and *Hard Applied* and the one between *StSt* and *Soft Pure* were insignificant. The negative interaction effect between *Hard Pure* and *StFac* meant that the slope between student-faculty interactions and the outcome variable was significantly less for students in hard applied academic areas when compared to students in soft applied academic areas. And significant

interaction effect between these variables meant that the slope difference was statistically significant. Further, the positive interaction effect between *StSt* and *Hard Pure* meant that the slope between student-student interactions and the outcome variable was significantly greater for students in hard pure academic areas than student in soft applied academic areas. Therefore, the effect of the variable student-faculty interactions and the effect of student-student interactions on graduating seniors' perceived collaborative learning skills depended on students' academic area.

Overall, the models in both Part I and Part II of this research question predicted the outcome variable *CLS* significantly. The nature of the relationship between *StFac* and *CLS* as well the relationship between *StSt* and *CLS* remained the same in each part of the analysis.

Table 7

Effects of the Variables StSt, StFac, Hard Applied, Hard Pure, Soft Pure, and their Interaction Effects on CLS

	Unstand. β	Stand. Error	Stand. β	Sig. α	R^2	F	Sig. α
Research Question 3							
Part I							
Model					.034	13.19	.00
Student-Faculty Interactions (*StFac*)	-.03	.04	-.02	.35			
Student-Student Interactions (*StSt*)	.29	.05	.13	.00			
Hard Applied (*Hard Applied*)	-.31	.10	-.09	.00			
Hard Pure (*Hard Pure*)	-.45	.10	-.12	.00			
Soft Pure (*Soft Pure*)	.03	.10	.01	.73			
Part II							
Model					.044	7.42	.00
Student-Faculty Interactions (*StFac*)	-.00	.04	-.00	.96			
Student-Student Interactions (*StSt*)	.29	.06	.13	.00			
Hard Applied (*Hard Applied*)	-1.04	2.92	-.30	.72			
Hard Pure (*Hard Pure*)	-5.26	1.91	-1.40	.00			
Soft Pure (*Soft Pure*)	-3.56	2.02	-.99	.08			
*StFac*Hard Applied*	-.04	.03	-.04	.27			
*StFac*Hard Pure*	-.10	.04	-.08	.00			
*StFac*Soft Pure*	-.05	.04	-.05	.15			
*StSt*Hard Applied*	.20	.73	.21	.79			
*StSt*Hard Pure*	1.23	.48	1.33	.01			
*StSt*Soft Pure*	.92	.50	1.04	.07			

Note. CLS=graduating seniors' perceived collaborative learning skills, *StFac*=student-faculty interactions, *StSt*=student-student interactions.

The inclusion of the interaction effects to the model in Part II did not change the non-significant relationship between *StFac* and the outcome and the significant relationship between *StSt* and the outcome. The interaction effect between *StSt* and *Hard Pure* as well as the interaction effect between *StFac* and *Hard Pure* were statistically significant. Thus, the relationship of student-student interactions and student-faculty interactions with the outcome variable was moderated by students' academic area.

Research Question 4

For the last research question the researcher examined if the relationship among student-student interactions, student-faculty interactions, and the outcome variable was moderated by students' retrospective perception of their collaborative learning skills. This question was answered in two parts to provide a comprehensive understanding of the relationships among variables of interest. In the first part, the variables *StFac*, *StSt*, and *RetroCLS* were added to the model as independent variables. And in the second part of the analysis, in addition to these three variables, the interaction effects were included in the model. In both parts the predictive capability of the model and the percentage of the variance explained in the outcome variable are discussed. In addition, the relationship between each independent variable and the outcome variable were explored. The following equation was used for the first part of the Research Question 4:

$$\widehat{CLS}_i = \hat{\beta}_0 + \hat{\beta}_1 StFac_i + \hat{\beta}_2 StSt_i + \hat{\beta}_3 RetroCLS_i + e_i$$

The results of the first step of the analysis indicated that the combination of *StFac*, *StSt*, and *RetroCLS* had statistically significant predictive capability with $F = 271.61$, $p < .01$ and explained 28% of the variance in graduating seniors' perceived collaborative learning skills.

Further investigation revealed that the relationship between *StSt* and *CLS* was significant with $\beta = .19$, $p < .01$. Further, the relationship between *RetroCLS* and *CLS* was statistically significant with $\beta = .39$, $p < .01$. However, the relationship between *StFac* and the outcome variables was found to be insignificant.

In the next step of the analysis, interactions effects were added to the model and it was considered how the nature and magnitude of the relationships of each independent variable with the outcome were changed. The following equation can be used to explore the relationships among variables student-faculty interaction, student-student interaction, and students' retrospective perception of their collaborative learning skills:

$$\widehat{CLS}_i = \hat{\beta}_0 + \beta_1 StFac_i + \hat{\beta}_2 StSt_i + \hat{\beta}_3 RetroCLS_i + \hat{\beta}_4 (StFac_i * RetroCLS_i) + \hat{\beta}_5 (StSt_i * RetroCLS_i) + e_i$$

The equation was also used to explore if the relationships of student-faculty interactions and student-student interactions with the outcome variable were moderated by students' retrospective perception of their collaborative learning skills.

According to the results, the combination of the independent variables has statistically significant predictive cabability with $F = 154.57$, $p < .01$. The combination of the independent variables in the second part explained 30% of the variance in the outcome variable. In addition, the interaction effect between *StFac* and *RetroCLS* as well as the interaction effect between *StSt* and *RetroCLS* were significant with $\beta = -.01$ and $\beta = .07$, respectively. The negative interaction effect between student-faculty and students' retrospective perception of their collaborative learning skills as a freshman means that the lower was *RetroCLS* the greater was the effect of student-faculty interactions on the outcome variable. The positive interaction effect

between student-student interactions and *RetroCLS* means the higher was students' *RetroCLS* the greater was the effect of student-student interactions on the outcome variable.

Overall, both of the models predicted a significant amount of the variance in the outcome. In each model the relationship between *StSt* and the outcome variable *CLS* was positive. Further, the relationship between *StFac* and the outcome was insignificant in each part of the analysis. The inclusion of the interaction effects between student-student interaction and *RetroCLS* as well as the interaction effect between student-faculty interactions and *RetroCLS* changed the relationship between *RetroCLS* and the outcome variable from being significant to being insignificant.

Table 8

Effects of the Variables StSt, StFac, RetroCLS as well as the Interaction Effects on CLS

	Unstand. β	Stand. Error	Stand. β	Sig. α	R^2	F	Sig. α
Research Question 4							
Part I							
Model					.28	271.61	.00
Student-Faculty Interactions (*StFac*)	-.04	.03	-.02	.21			
Student-Student Interactions (*StSt*)	.19	.04	.08	.00			
RetroCLS (*RetroCLS*)	.39	.01	.52	.00			
Part II							
Model					.30	154.57	.00
Student-Faculty Interactions (*StFac*)	.03	.04	.02	.42			
Student-Student Interactions (*StSt*)	.16	.06	.07	.00			
RetroCLS (*RetroCLS*)	.14	.09	.18	.12			
*StFac*RetroCLS*	-.01	.00	-.12	.00			
*StSt*RetroCLS*	.07	.02	.36	.00			

Note. Sample size is 1852. *CLS*=graduating seniors' perceived collaborative learning skills, *StFac*=student-faculty interactions, *StSt*=student-student interactions, *RetroCLS*=students' retrospective perception of their collaborative learning skills.

Finally, the effect of student-student interactions on the outcome as well as the effect of student-faculty interactions on the outcome variable depended on students' retrospective perception of their collaborative learning skills. While the interaction effect between student-

faculty interactions and students' retrospective perception of their collaborative learning skills was negative, the interaction effect between student-student interaction and students' retrospective perception of their collaborative learning skills was positive. Thus, the relationship of student-student interaction and student-faculty interactions with graduating seniors' perceived collaborative learning skills was moderated by students' retrospective perception of their collaborative learning skills as freshmen.

Summary

In this chapter the researcher addressed the four research questions and explored the relationship of student-student interactions and student-faculty interactions with seniors' perceived collaborative learning skills. The researcher examined the nature and magnitude of this relationship and studied if it was moderated by students' gender, academic area, and students' retrospective perception of their collaborative learning skills. According to the results, the relationship between student-student interactions and the outcome variable was positive and this positive relationship persists even after controlling for the other independent variables in the study. However, the relationship between student-faculty interactions and the seniors' collaborative learning skills was insignificant. Further results revealed that the relationship of student-student interactions and student-faculty interactions with the outcome variable was moderated by students' gender. More specifically, when compared to female students, the relationship between student-faculty interactions and the outcome variable was weaker for male students, while the relationship between student-student interactions and the outcome variable was stronger for male students. In addition, the relationship of student-student interactions and student-faculty interactions with seniors' perceived collaborative learning skills was moderated by students' academic area. For instance, the relationship between student-faculty interactions

and the outcome variable was weaker for students in hard pure academic areas when compared to students in soft applied academic areas. Also, the relationship between student-student interactions and the outcome variable was stronger for student in hard pure academic areas when compared to student in soft applied academic areas. Finally, the relationship of student-student interactions and student-faculty interactions with the outcome variable was moderated by students' retrospective perception of their collaborative learning skills. The higher students' retrospective perception of their collaborative learning skills the weaker the effect of student-faculty interactions was on the outcome variable. And the higher students' retrospective perception of their collaborative learning skills the stronger was the effect of student-student interactions on the outcome variable.

Chapter 5

Discussion of Results

Introduction

The purpose of this study was to examine the relationships between gender, academic areas (hard pure, hard applied, soft pure, and soft applied), interactions with faculty and with other students, and students' perceived level of collaborative learning skills as graduating seniors and retrospective to their entering the university. Given the paucity and inconclusiveness of research on the relationship between students' interaction with faculty and their peer and college graduates' collaborative learning skills, this study was aimed to build on that small base of research and to provide some answers to this area of inquiry. Based on the increasing focus on the importance of collaborative learning skills as a crucial college learning outcome (Hart Research Associates, 2010), this study was designed to seek to further expand previous research in which researchers suggested a link between collegiate experiences and college graduates' collaborative learning skills (Chi et al., 2008). Last, absent from the literature pertaining to collaborative learning skills, student-student interactions, and student-faculty interaction was an exploration of whether certain experiences differ for different kinds of students. While in some studies researchers have investigated the conditional effects of collegiate experiences (Kim & Sax, 2007, 2009; Sax et al., 2005), this is one of the very few studies, if not the first one, to explore whether student-student interactions and student-faculty interactions differ for different types of students, and how those differences relate to students' collaborative learning skills (*CLS*).

To investigate the interrelationships among student-student interactions, student-faculty interactions, and collaborative learning skills of college graduates, data were analyzed from an

institutional investigation of seniors' demographics, perceptions of their collegiate experiences and their skills and abilities, as well as their future plans after graduating from college. In particular the impact of student-student interactions and student-faculty interactions on college graduates' collaborative learning skills were estimated on a self-reported perception of students' collaborative learning skills composite score. The composite score consisted of students' perceptions of their oral communication skills, leadership skills, interpersonal/social skills, and their ability to communicate with people different from themselves. Statistical controls were introduced for potential confounding influences such as gender and students' academic area and their retrospective perception of their collaborative learning skills.

Based on the findings from this single-institutional, cross-sectional study the researcher suggests that student-student interactions positively impact graduating seniors' *CLS*. The significant impact of student-student interactions on exiting seniors' perceived level of *CLS* exists even after controlling for students' gender, academic area, and their retrospective perception of their *CLS* as freshmen. Graduating seniors' experiences and involvement in college are influential in their perceptions of *CLS*. In other words, the perceptions of *CLS* are clearly fostered and influenced by the college milieu.

In this chapter, the researcher will present a discussion of the results integrated with limitations of the study, discussion of results, directions for future research, and policy implications of this research.

Key Findings and Conclusions

Based on the current study's findings the combination of the variables student-student interactions and student-faculty interactions significantly predicted graduating seniors' perception of collaborative learning skills. In addition, it was revealed that the relationship

between student-student interactions and students' perceived collaborative learning skills was positive, whereas the relationship between student-faculty interactions and students' collaborative learning skills was non-significant. Further, the relationship of student-student interactions and student-faculty interactions with students' perceived collaborative learning skills was moderated by students' gender, academic area and students' retrospective perception of their collaborative learning skills as freshmen.

The influences that impact college students' learning are many and complexly interrelated. This study was designed to examine some of those forces as comprehensively as possible and provided insight into the relationships among the variables of interest. According to the present study's results of the simultaneous multiple regression, where the covariates were not controlled, the only significant relationship exists between student-student interaction and graduating seniors' collaborative learning skills. This significant relationship between these two variables was observed in the presence of the aforementioned controls for potential confounding influences. The significant and positive relationship of student-student interactions with collaborative learning skills is consistent with some previous research on the subject (Astin, 1993; Kim & Sax, 2007). The non-significant relationship of student-faculty interactions with students' learning outcome is consistent with many of the previous evidence (Kim & Sax, 2009; Sax et al., 2005). The finding that the relationship of student-student interactions and student-faculty interactions was moderated by students' gender was consistent with previous research (Kim & Sax, 2007; Sax, 2008). These results echo those of Sax (2008) who found that gender affected the relationships among most other variables. Care should be taken not to overgeneralize the results of the present research. In this study the researcher focused on disciplinary differences and gender differences at one university in the southeastern United States and may be unique to

that university. Even if the results are typical of disciplinary different at some other universities, they may not be applicable to many other colleges and universities. Additional research across a variety of different types of institutions is needed to assess the effects of disciplinary and gender differences on students' collegiate experiences and educational outcomes.

The significant impact of student-student interactions on learning outcomes is also supported by Astin's (1993) findings. He reported that students' interactions with their peers was the single most powerful factor on undergraduate students' personal and intellectual development. Further, Astin reported that student-student interaction had its strongest positive effects on leadership development, overall academic development, self-reported growth in problem-solving skills, critical thinking skills, and cultural awareness. The powerful influence of peer interactions is well documented in the literature (Chang, 1999; Chang, Denson, Saenz, & Misa, 2005; Gurin, Dey, Hurtado, & Gurin, 2002; Nelson Laird, 2005). Next to the peer group, faculty represented the most significant aspect of the students' undergraduate development (Astin, 1993).

According to the current study's results, students' academic area was found to be significantly related to graduates' collaborative learning skills. In the present study the researcher divided students into Biglan's (1973) four academic areas (i.e., hard applied, hard pure, soft applied, and soft pure) according to their reported majors. Academic areas such as hard applied and hard pure were significantly related to the outcome variable. Being in a soft pure academic area was not related to the outcome variable. These differences based on academic classification echo findings of Li and his colleagues (1999) who found that students' learning environments, social integration, and learning and intellectual development varied by major. Other researchers have reported that students in applied academic areas held more positive views of the college

environment than did students in pure academic areas (Pike & Killian, 2001). In the same study, researchers found that the absolute levels of academic and social involvement were lower for students in applied academic areas. Further, students in applied academic areas reported making substantially greater improvement in their vocational competence development than did students in pure academic areas. However, general educational gains were lower for students in applied academic areas than for students in pure academic areas.

Numerous researchers reported a significant relationship between student-student interactions and college students' learning outcomes (Astin, 1993; Cruce et al., 2006; Pascarella & Terenzini, 1991, 2005). This study's results can be used to supplement and highlight the growing evidence that student-student interactions significantly impact college students' learning outcomes as it reports a significant relationship between student-student interactions and collaborative learning skills. College impact studies are continually designed to examine the effects of programmatic, curricular, and co-curricular experiences on student learning. Findings from this study can be used to provide evidence to suggest that examining the effects of college experiences only at the programmatic level is not enough to measure the extent to which student engage in intentionally meaningful and developmentally-productive practices. Yet, future researchers should not dismiss the impacts of other campus programs as a mechanism to increase students CLS, including service learning, learning communities, senior capstones, and the like.

Implications for Future Research

In this section the researcher provides the implications from the present study for future research. Discussed will be the complexity of the college impact research and how this complexity can be overcome. Further, the researcher suggests how a more comprehensive

understanding can be gained when studying the relationship between collegiate experiences including students' interactions with their peer and faculty and their collaborative learning skills.

According to the results of the present study, the relationship of student-student interactions and student-faculty interaction with seniors' perceived collaborative learning skills was moderated by students' academic area. Based on this fact the researcher suggests including students' academic area as a moderator when exploring the relationships among student characteristics, collegiate experiences and learning outcomes. Clearly, the influence of academic areas on students' collegiate experiences and learning outcomes remains fertile ground for research.

Previous research provide evidence that collaborative learning skills was identified as one of the crucial learning outcomes needed in college students' career and has impact on overall student learning and intellectual development of college students. As students collaborate with others in solving problems they have the opportunity to think about and apply what they have learned in different settings. Furthermore, collaborative learning environments promote students' acquisition of valuable skills that they will need to succeed after college (Kuh, Kinzie, Schuh, & Whitt, 2010). Colleges and universities are expected to ensure graduates obtain more from their education than general knowledge including the ability to think critically, working with other on defined problems. However, there are still many unanswered questions about how students actually acquire these higher order intellectual abilities and become successful collaborators. Furthermore, researchers need to be aware of the complexity to fully capture as many facets of these higher order skills as they can. One way of dealing with this issue is using previous theory and empirical research and knowing that no one theory or model is good enough to fully capture the depth of these variables.

In this study, the student-faculty interactions composite score consisted of indicators asking students about their in-class interactions with faculty, their out-of-class interactions with faculty, instructor's concern for students, and faculty accessibility outside class. This composite score was an indicator of how students perceived their interactions with faculty and fails to reflect what faculty thinks about their interactions with students. For future studies it is suggested to explore the perceptions of faculty regarding the nature and amount of their interactions with students. Further, it can be measured how faculty organizes class time, to what extent interactions with students are enabled and the importance they place on collaborative learning activities. This way, students' reports of their perceptions of their interactions with faculty and results from faculty survey can be combined to fully understand how and why student-faculty interactions influence college students' collaborative learning skills. The results can be combined to determine the extent to which faculty activities and student experiences are aligned in regard to collaborative learning. In their study, Kuh, Laird, and Umbach (2004) provide evidence that faculty of color and women are more likely than their counterparts to value and use collaborative learning activities in classroom. Furthermore, they reported that the more years a faculty member has taught, the less likely he or she is to use active and collaborative learning activities or think it is important for students to take part in a learning community (Kuh, et al., 2004; Umbach & Wawrzynski, 2005).

Priority of a university should be to create a community where students and faculty share work and academic goals (Boyer, 1990). One of the important goals of this community is to strengthen students' collaborative learning skills (Astin, 2012) as this is a key factor impacting educational gains (Kuh et al., 1997). Chickering and Gamson (1987) have demonstrated that collaboration among college students related to positive student outcomes. Collaborative

activities in the classroom are some of the most effective means for increased conceptual gains and enjoyment of the learning task (Cooper, 1999). The extent to which a college environment fosters collaborative learning skills and how effective it is in doing so needs to be assessed using different assessment tools (Summers et al., 2005).

The analyses for the current study were conducted using secondary data and are limited the extent to which the researcher could construct and incorporate specific survey items to accurately assess the effects on *CLS* of all potentially relevant covariates as guided by prior research. As previously detailed, the primary purpose of the senior survey was to capture graduating seniors' perceptions of their collegiate experiences and their perceived level of skills and abilities. To this end, perceptions of students were primary focus of the survey and therefore the survey was an indirect measure of students' skills and abilities. To compensate for this limitation, a direct measure of students' skills and abilities especially of collaborative learning skills could be incorporated into the analyses. Researchers can provide a comprehensive understanding of the factors influencing collaborative learning skills of students as they combine data from both students and faculty. Future research is likely to be more informative and useful for practice and policy if the frameworks and approaches incorporate not only students' experiences and their perceptions of their interactions with faculty and other peers but measures of faculty's perception of their interactions with students. Furthermore, an integration of the results and analyses from these two scale can be used by researchers to explore the interrelationships among variables and if the relationships are moderated by certain student and faculty characteristics, values, or perceptions. Also, direct measures of the discussed variables could be utilized to support the findings derived from self-reports. Although, the use of self-reports of the collegiate experiences and academic development as proxies was considered being

appropriate, researchers' use of direct measures to support the results derived from self-reports was strongly encouraged (Pike, 1995).

College impact researchers aim to identify and statistically control for the effects of precollege factors in order to better isolate and estimate the impact of curriculum, co-curriculum, and other college experiences on a given student outcome such as *CLS*, the outcome of focus in the present study. Future research, particularly research that involves the survey design, can include recognition of the importance of obtaining precollege information that may potentially influence their intended outcome. Furthermore, in future college impact studies researchers need to carefully and fully capture the factors that influence students' acquisition of knowledge and development of skills and abilities. In the meantime the researchers need to be aware that current theories and models focus on specific collegiate experiences and therefore unable to provide a complete picture of the forces in play (Pascarella & Terenzini, 2005). Although it may not be reasonable to expect any scale to capture every possible dimension of a construct, researchers need to be aware that most of the research based on existing theories and models can only provide a partial image of the dynamics and interrelationships of variables.

Given the finding that student-faculty interactions was insignificant in the general effects model but was significantly moderated by students' gender, academic area, and students' retrospective perception of their collaborative learning skills raises a potentially important point. The fact that significance was found only among conditional effects was consistent with Pascarella's (2006) suggestion for researchers to investigate whether college experiences differentially impact different types of students. Whereas much of the existing literature on the impact of college on students focuses on general effects (Pascarella, 2006), this study was designed to illustrate the importance of exploring whether these experiences differ for different

types of students. It is strongly recommended to focus on conditional effects to overcome the shortcomings of the extant literature on college impacts and to gain a comprehensive understanding of the phenomena. The importance of the need for more research on conditional effects is also supported by dramatic increases that are predicted in the number of racial and ethnic minorities in the U. S and subsequent increases in higher education. Although some important and statistically significant conditional effects were uncovered in the present study, the inclusion of more variables related to students' precollege characteristics such as SES, parental education, SAT scores, and academic achievement in high school may provide even greater insight into how collegiate experiences differentially influences different type of students. Although the researcher found significant conditional effects in the current study, higher order conditional effects were not explored given the lack of more and complex data. Sax points to the lack of studies where higher order conditional effects are examined in order to gain more insight into the differential effects of collegiate experiences on different type of students (Sax, 2008). Higher order conditional effects could be used to explore if, for instance, female students in hard pure academic areas were more affected by student-student interactions than their counterparts in soft applied academic areas.

To summarize, the influence of collegiate experiences on college students' collaborative learning skills and the extent to which this is conditional on student characteristics is a fertile ground for research. However, researchers examining the relationships between students' collegiate experiences and any learning outcomes including CLS need to be aware of the complexity of the phenomena. To overcome this complexity and in order to get a comprehensive understanding of the issues the researchers, when possible, should rely on more than one

instrument, collect data from both students and faculty, integrate results of both qualitatively and quantitatively collected data.

Implications for Practice

The findings from this present study – particularly the effects of student-student interactions and student-faculty interactions on seniors' perceived collaborative learning skills can be used to inform practitioners and faculty about the relationship between students' collegiate experiences and their perceived collaborative learning skills. Furthermore, the results can be used as evidence that both student-student interactions and student-faculty interactions influence students differently based on their gender, academic area, and the retrospective perception of their collaborative learning skills. In this section, the implications of the present study for practice are summarized. Further, it will be discussed what changes can be made by faculty, administrators, and practitioners in higher education in order to create a college learning environment where the importance collaborative learning skills is stressed and its development is fostered. Further, how faculty and administrators can shape students' interactions with other students and the faculty to promote students' collaborative learning skills is discussed.

The findings of this study can be used to suggest practical implications for administrators and faculty members, pointing them some of the potentially important collegiate experiences and their impacts on college graduates' collaborative learning skills. With the findings of the current study, the researcher emphasizes the extent to which faculty and administrators can shape the kinds of experiences students have.

Providing theory and research emphasizing the relationship of student-student interactions, student-faculty interactions and seniors' perceived collaborative learning skills would help faculty gain a better understanding of the dynamics. If colleges and universities

advertise a specific skill or ability as a particularly salient student outcome, they need to be more purposeful in understanding the development of that skill or ability in their students (Pascarella & Terenzini, 2005). Using the present study as an example, colleges and universities might consider promoting activities that encourage variables that influence CLS. Faculty members need to commit to the development of collaborative learning skills by teaching students what it means to be an effective teammate, asking students to practice working in teams, and offering feedback about the development of students' collaborative learning skills (Bain, 2004; Fink, 2003).

In the present study, the absence of a significant relationship between student-faculty interactions and students' perceived collaborative learning skills suggests that simply encouraging interactions with faculty will not produce the desired learning outcomes. In addition to that, a campus environment needs to encourage application of knowledge and provide supportive relationships among students, faculty, and staff (Hughes & Jones, 2011). Practitioners might enhance students' collaborative learning skills through the encouragement of meaningful relationships between students and faculty. Faculty should also be encouraged to recognize the broader influence of their relationships with students beyond specific academic domains and engage students specifically in important conversations relating to collaborative learning skills. This study contributes to professionals affiliated with student affaris and other campus units to serve effectively serve student benefits. Faculty, staff, and policy makers should familiarize themselves with the dynamics influencing students' perceptions of collaborative learning and know that students of different gender and academic areas are impacted differently by their interactions with peers and faculty. As faculty are informed about the fact that students with different characteristics may respond differently to a given educational experience, they could tailor the pedagogy to meet individual students' needs. In addition, the current study provides

information to develop higher education programs and services that maximize the benefits of college for all students.

From their analyses of National Survey of Student Engagement data from 20,226 senior students and Faculty Survey of Student Engagement from 14,336 faculty members, Kuh et al., 2004 reported how faculty attitudes toward certain learning activities and student involvement aligned. Further, they reported that there was an alignment between faculty's pedagogical approaches and priorities and students' learning outcomes. Faculty's pedagogical approaches promote students' involvement in effective educational practices, and this involvement results in better outcomes. The same was true for the relationship between faculty's priorities and students' attitudes. According to their results, even after controlling for potentially confounding variables, at institutions where faculty value experiences with diversity, students report more frequent conversations with other students whose background is different from their own. This was also the case for active and collaborative learning; when faculty members valued such activities students more frequently worked together on projects in class. That is, if faculty members at an institution emphasized an activity, required students to do it, students at that institution tended to do it and gained expertise in the area (Kuh et al., 2004). These results are supported by Pascarella and Terenzini's decades of research studies on student development. They suggest that students who engage in a variety of educationally purposeful activities report gaining more from college compared with their peers who engage less frequently in such activities (Pascarella & Terenzini, 2005). Also, there found to be an alignment with faculty's use of active and collaborative educational practices and students' being involved in such activities. Thus, faculty's priorities in regard to educational practices were reflected in students' attitudes and gains in personal and intellectual development related to those educational practices (Kuh et al., 2004). Using these

findings, researchers highlight the complex interconnections among the multiple influences that shape students' collaborative learning skills. In so doing, the results reported here also point to the need, when policy decisions are being made, for greater awareness of the factors and dynamics at work in students' college education.

Summary

This study can be used to add to the literature for a number of reasons. First, results contribute to the limited body of research examining the relationship between collegiate experiences such as student-student interactions and student-faculty interactions with collaborative learning skills. Second, this research can be used to provide insight that student-faculty interactions was not a significant factor predicting seniors' collaborative learning skills. Last, this study is significant in that it was intended to reveal some important findings how these relationships are moderated by students' gender, academic area, and their retrospective perception of their collaborative learning skills.

Based on the findings of the current study the researcher suggests that graduating seniors' interactions with their peers are particularly influential in their perceived level of *CLS*. Furthermore, students' gender, academic area, and students' retrospective perception of their CLS as freshmen ultimately influence their *CLS* as graduating seniors. These findings can be used to provide powerful evidence that the college environment and student-student interactions can significantly impact graduating seniors' *CLS*.

References

Adelman, C. (1998). *Women and men of the engineering path: A model for analyses of undergraduate careers* (Document No. PLLI 98-8055). Washington, DC: U.S. Department of Education and National Institute for Science Education.

Akgun, A. E., Lynn, G. S., & Byrne, J. (2003). Organizational learning: A socio-cognitive framework. *Human Relations, 56*(7), 839-868.

Allard-Poesi, F. (1998). Representations and influence processes in groups: Toward a sociocognitive perspective on cognition in organization. *Scandinavian Journal of Management, 14*(4): 395-420.

Allen, B., & Niss, J. (1990). A chill in the college classroom? *Phi Delta Kappa,* 71, 607-609.

Allison, P. D. (1999). *Logistic regression using SAS: Theory and application*. Cary, NC: SAS Publishing.

Allison, P. D. (2002). *Missing data*. Thousand Oaks, CA: Sage.

Altbach, P. G., & Knight, J. (2007). The internationalization of higher education: Motivations and realities. *Journal of Studies in International Education, 11*(3-4). 290-305.

Anaya, G. (1992). *Cognitive development among college undergraduates*. Unpublished doctoral dissertation, University of California, Los Angeles.

Anaya, G. (1996). College experiences and student learning: The influences of active learning, college environment, and cocurricular activities. *Journal of College Student Development,* 37, 611-622.

Anaya, G. (1999). College impact on student learning: Comparing the use of self-reported gains, standardized test scores, and college grades. *Research in Higher Education, 40*(5), 499-526.

Andriessen, J., Baker, M., & Suthers, D. (2003). Argumentation, computer support, and the educational context of confronting cognitions. In J. Andriessen, M. Baker, and D. Suthers (Eds.) *Arguing to Learn: Confronting Cognitions in Computer-Supported Collaborative Learning Environments*. Dordrecht, Netherlands: Kluwer Academic.

Argote, L., & Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. *Organizational Behavior & Human Decision Processes, 82*(1), 150-169.

Argote, L., Ingram, P., Levine, J., & Moreland, R. (2000). Knowledge transfer in organizations. *Organizational Behavior and Human Decision Processes, 82*(1), 1-8.

Association of American Colleges and Universities (AAC&U). (2007). *College learning for the new global century: A report from the National Leadership Council for Liberal Education and America's Promise*. Washington, DC: Association of American Colleges and Universities. Retrived from http://www.aacu.org/leap/documents/GlobalCentury_final.pdf

Asterhan, C. S. C., & Schwarz, B. B. (2009). Argumentation and explanation in conceptual change: Indications from protocol analyses of peer-to-peer dialog. *Cognitive Science, 33*, 374-400.

Asterhan, C. S. C., & Schwarz, B. B. (2010). Argumentation and reasoning. In K. Littleton, C. Wood, & J. K. Staarman (Eds.) *International Handbook of Psychology in Education* (pp. 137-176). Bradford, UK: Emerald Group.

Astin, A. W. (1977). *Four critical years: Effects of college on beliefs, attitudes, and knowledge*. San Francisco, CA: Jossey-Bass.

Astin, A. W. (1984). Student involvement: A developmental theory for higher education. *Journal of College Student Personnel, 25*(3), 297-308.

Astin, A. W. (1993). *What matters in college: Four critical years revisited*. San Francisco, CA: Jossey-Bass.

Astin, A. W. (2012). *Assessment for excellence: The philosophy and practice of assessment and evaluation in higher education* (2nd ed). Phoenix, AZ: Rowman & Littlefield.

Astin, A., & Astin, H. (1993). *Undergraduate science education: The impact of different college environments on the educational pipeline in the sciences*. Los Angeles, CA: University of California, Graduate School of Education, Higher Education Research Institute.

Astin, A. W., & Sax, L. J. (1998). How undergraduates are affected by service participation. *Journal of College Development, 39*(3), 251-263.

Aud, S., Hussar, W., Kena, G., Bianco, K., Frohlich, L., Kemp, J., & Tahan, K. (2011). *The condition of education 2011.* U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

Audi, R. (1998). *Epistemology: A contemporary introduction to the theory of knowledge*. New York, NY: Routledge.

Bain, K. (2004). *What the best college teachers do*. Cambridge, MA: Harvard University.

Bandura, A. (1977). *Social learning theory.* Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1986). *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist, 44*(9), 1175-1184.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York, NY: W. H. Freeman.

Bandura, A. (2002). Social cognitive theory in cultural context. *Applied Psychology: An International Review, 51*(2), 269-290.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior*, *31*(2), 143-164.

Barkley, E. F., Cross, K. P., & Major, C. H. (2005). *Collaborative learning techniques: A handbook for college faculty*. San Francisco, CA: Jossey-Bass.

Barron, B. (2000). Achieving coordination in collaborative problem-solving groups. *The Journal of the Learning Sciences, 9*(4), 403–436.

Barron, B., Schwartz, D. L., Vye, N. J., Moore, A., Petrosino, A., Zech, L., & Bransford, J. D. (1998). Doing with understanding: Lessons from research on problem-and project-based learning. *Journal of the Learning Sciences, 7(3-4),* 271-311.

Becher, T. (1994). The significance of disciplinary differences. *Studies in Higher Education, 19*(2), 151-161.

Bernard, R. M., Rubalcava, B. R., & St.Pierre, D. (2000). Collaborative online distance learning: Issues for future practices and research. *Distance Education, 21*(2), 260–277.

Berry, W. D., & Feldman, S. (1985). *Multiple regression in practice: Series on quantitative applications in the social sciences*. Newbury Park, CA: Sage.

Biglan, A. (1973). The characteristics of subject matter in different academic areas. *Journal of Applied Psychology*, *57*(3), 195-203.

Black, K. M. (1994). An industry view of engineering education. *Journal of Engineering Education*, *83*, 26-28.

Bosworth, K. (1994). Developing collaborative skills in college students. *New Directions for Teaching and Learning*, 59, 25-31.

Bowen, H. R. (1977). *Investment in learning: The individual and social value of American higher education*. San Francisco, CA: Jossey-Bass.

Boyer, E. L. (1987). *The undergraduate experience in America*. New York, NY: Harper Collins.

Boyer, E. L. (1990). *Campus life: In search of community*. San Francisco, CA: The Carnegie Foundation for the Advancement of Teaching.

Brady, K., & Eisler, R. (1996, August). *Gender equity in the college classroom*. Paper presented at the meeting of the American Psychological Association, Toronto, Canada.

Bryant, J. A., & Bradley, J. L. (1993). Enhancing academic productivity, student development and employment potential. *NIRSA Journal, 18*, 42-50.

Cabrera, A. F., Nora, A., Terenzini, P. T., Pascarella, E., & Hagedorn, L. S. (1999). Campus racial climate and the adjustment of students to college: A comparison between White students and African-American students. *Journal of Higher Education*, 70, 134-160.

Campbell, J. W., & Blakey, L. S. (1996, May). *Assessing the impact of early remediation in the persistence and performance of underprepared community college students*. Paper presented at the 36th Annual Forum of the Association for Institutional Research, Albuquerque, NM.

Campbell, T. A., & Campbell, D. E. (1997). Faculty/student mentor program: Effects on academic performance and retention. *Research in Higher Education*, *38*(6), 727-742.

Chai, C. S., & Tan, S. C. (2009). Professional development of teachers for computer-supported collaborative learning: A knowledge-building approach. *Teachers College Record, 111*(5), 1296–1327.

Chang, M. J. (1999). Does racial diversity matter?: The educational impact of a racially diverse undergraduate population. *Journal of College Student Development, 40*, 377-395.

Chang, M. J., Denson, N., Saenz, V., & Misa, K. (2005). The educational benefits of sustaining

cross-racial interaction among undergraduates. *Journal of Higher Education, 77*, 430-455.

Chatterjee, S., & Hadi, A. S. (2012). *Regression analysis by example* (5th ed). Hoboken, NJ: John-Willey.

Chi, M. T. H. (2000). Self-explaining expository texts: The dual processes of generating inferences and repairing mental models. In R. Glaser (Ed.), *Advances in Instructional Psychology* (pp. 161-238). Mahwah, NJ: Erlbaum.

Chi, M. T. H., de Leeuw, N., Chiu, M. H., & LaVancher, C. (1994). Eliciting self-explanations improves understanding. *Cognitive Science, 18,* 439-47.

Chi, M. T. H., Roy, M., & Hausmann, R. G. M. (2008). Observing tutorial dialogues collaboratively: Insights about human tutoring effectiveness from vicarious learning. *Cognitive Science, 32,* 301- 341.

Chickering, A. W., & Gamson, Z. F. (1987). Seven principles for good practice in undergraduate education. *AAHE Bulletin, 39*(7), 3-7.

Cicourel, A. V. (1990). The integration of distributed knowledge in collaborative medical diagnosis. In J. Galegher, R. Kraut, & C. Egjdo, (Eds.), *Intellectual Teamwork* (pp. 221-242). Hillsdale, NJ: Lawrence Erlbaum.

Cohen, E. G. (1994). Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research*, 64, 1–35.

Cohen, J., & Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences.* Hillsdale, NJ: Lawrence Erlbaum.

Colbeck, C. L., Cabrera, A. F., & Terenzini, P. T. (2001). Learning professional confidence: Linking teaching practices, students' self-perception, and gender. *The*

Review of Higher Education, 24(2), 173-179.

Colbeck, C. L., Camphell, S. E., & Bjorklund, S. A. (2000). Grouping in the dark: What college students learn from group projects. *Journal of Higher Education, 71*, 60-83.

Cole, D. (2004, November). *Minority students' faculty contact and the impact on their GPA.* Paper presented at the annual meeting of the Association for the Study of Higher Education, Kansas City, MO.

Coleman, E. B. (1998). Using explanatory knowledge during collaborative problem solving in science. *Journal of the Learning Sciences, 7(3-4),* 387-427.

Coleman, R. J. (1996). *The engineering education coalitions*. ASEE Prism, *6*, 24-31.

Cooper, M. A. (1999). Classroom choices from a cognitive perspective on peer learning. In M. A. O' Donnell & A. King (Eds.), *Cognitive Perspectives on Peer Learning. The Rutgers Invitational Symposium on Education Series* (pp. 215-233). Mahawah, NJ: Lawrence Erlbaum.

Cornelius, R., Gray, J., & Constantinople, A. (1990). Student-faculty interaction in the college classroom. *Journal of Research and Development in Education*, 23, 189-197.

Cruce, T. M., Wolniak, G. C., Seifert, T. A., & Pascarella, E. T. (2006). Impacts of good practices on cognitive development, learning orientations, and graduate degree plans during the first year of college. *Journal of College Student Development, 47*(4), 365-383.

Datnow, A., Solorzano, D. G., Watford, T., & Park, V. (2010). Mapping the terrain: The state of knowledge regarding low-income youth access to postsecondary education. *Journal of Education for Students Placed at Risk, 15*, 1-8.

Dempster, A. P, Laird, N. M, & Rubin, D. B. (1977). Maximum likelihood from incomplete data via the EM algorithm. *Journal of Royal Statistical Society, 39*(1), 1-38.

DesJardins, S., Kim, D., & Rzonca, C. (2002-2003). A nested analysis of factors affecting bachelor's degree completion. *Journal of College Student Retention*, 4, 407-435.

Dey, E. (1991, March). *Community service and critical thinking: An exploratory analysis of collegiate influences*. Paper presented at the meeting of the conference Setting the Agenda for an Effective Research Strategy for Combining Service and Learning in the 1990s, Racine, WI.

Dillenbourg, P. (1999). What do you mean by collaborative learning? In P. Dillenbourg (Ed.), *Collaborative-learning: Cognitive and Computational Approaches* (pp. 1–19). Oxford, United Kingdom: Elsevier.

Douzenis, C. (1996). The relationship of quality of effort and estimate of knowledge gain among community college students. *Community College Review*, *24*(3), 27-35.

Endo, J., & Harpel, R. (1982). The effect of student-faculty interaction on students' educational outcomes. *Research in Higher Education, 16*(2), 115-138.

Fassinger, P. (1995). Understanding classroom interaction. Students' and professors' contributions to students' silence. *Journal of Higher Education*, 66, 82-96.

Feldman, K. A., Smart, J. C, & Ethington, C. A. (1999). Major field and person-environment fit: using Holland's theory to study change and stability of college students. *Journal of Higher Education, 70*(6), 642-669.

Fenske, R., Porter, J., & DuBrock, C. (2000). Tracking financial aid and persistence of women, minority, and needy students in science, engineering, and mathematics. *Research in Higher Education*, 41, 67-94.

Ferris, G. R., Witt, L. A., & Hochwarter, W. A. (2001). Interaction of social skill and general mental ability on job performance and salary. *Journal of Applied Psychology, 86*(6), 1075-1082.

Fink, L. D. (2003). *Creating significant learning experiences: An integrated approach to designing college courses*. San Francisco, CA: Jossey-Bass.

Fischer, F., Bruhn, J., Gräsel, C., & Mandl, H. (2002). Fostering collaborative knowledge construction with visualization tools. *Learning and Instruction*, *12*(2), 213-232.

Fiske, S. T., & Taylor, S. E. (1991). *Social cognition*. New York, NY: McGraw Hill.

Flowers, L., Osterlind, S., Pascarella, E., & Pierson, C. (2001). How much do students learn in college? Cross-sectional estimates using the College Basic Academic Subjects Examination. *Journal of Higher Education, 72*(5), 565-583.

Franklin, M. (1993). *The effects of differential college environments on academic learning and student perceptions of cognitive development*. Unpublished doctoral dissertation, University of Nebraska, Lincoln.

Franklin, M. (1995). The effects of differential college environments on academic learning and student perceptions of cognitive development. *Research in Higher Education*, *36*(2), 127-153.

Frost, S. H. (1991). Fostering the critical thinking of college women through academic advising and faculty contact. *Journal of College Student Development,* 32, 359-366.

Gherardi, S. (1998). Competence—the symbolic passe-partout to change in a learning organization. *Scandinavian Journal of Management*, 14, 373–393.

Gillies, R. M. (2004). The effects of cooperative learning on junior high school students during small group learning. *Learning and Instruction, 14*(2), 197-213.

Gioia, D., & Sims, H. (1986). Introduction: Social cognition in organizations. In H. P. Sims, & D. A. Gioia (Eds.), *The thinking organization: The dynamics of organizational social cognition* (pp. 1 – 11). San Francisco, CA: Jossey-Bass.

Glanz, K., Lewis, F. M., & Rimer, B. K. (1990). *Health behavior and health education: Theory, research, and practice*. San Francisco, CA: Jossey-Bass.

Goldman, A. L. (1986). *Epistemology and cognition*. Cambridge, MA: Harvard University Press.

Gruenfeld, D. H., & Hollingshead, A B., (1993). Socicognition in work groups. *Small Group Research, 24*(3): 383-405.

Gurin, P., Dey, E., Hurtado, S., & Gurin, G. (2002). Diversity and higher education: Theory and impact on educational outcomes. *Harvard Educational Review, 72*, 330-366.

Hagedorn, L. S., Siadat, M. V., Nora, A., & Pascarella, E. T. (1997). Factors leading to gains in mathematics during the first year of college: An analysis by gender and ethnicity. *Journal of Women and Minorities in Science and Engineering*, 3, 185-202.

Hall, R., & Sandler, B. (1982). The campus climate: A chilly one for women? Report of the Project on the Status and Education of Women. Washington, DC: Association of American Colleges.

Hall, R., & Sandler, B. (1984). *Out of the classroom: A chilly campus climate for women?* Report of the Project on the Status and Education of Women. Washington, DC: Association of American Colleges.

Hart Research Associates. (2010). *Raising the bar: Employers' views on college learning in the wake of economic downturn*. Washington, DC: Hart Research Associates. Retrieved September 2, 2013, from http://www.aacu.org/leap/documents/2009_EmployerSurvey.pdf.

Hausmann, R. G. M. (2006). Why do elaborative dialogs lead to effective problem solving and deep learning? In R. Sun & N. Miyake (Eds.), *Proceedings of the 28th Annual Meeting of the Cognitive Science Society* (pp. 1465-1469). Vancouver, Canada: Sheridan Printing.

Hausmann, R. G. M., Nokes, T. J., VanLehn, K., & Van de Sande, B. (2009). Collaborative dialog while studying worked-out examples. In V. Dimitrova, R. Mizoguchi, B. Du Boulay, & A.C. Graesser (Eds.) *Artificial Intelligence in Education*. Amsterdam, Netherlands: IOS Press.

Hills, H. (2007). *Team-based learning*. Burlington, VT: Gower.

Hilton, T., Hsia, J., Solorzano, D., & Penton, N. (1989). *Persistence in science of high-ability minority students.* Research Report No. 89-28. Princeton, NJ: Educational Testing Service.

Hofstede, G., & Hofstede, G. J. (2005). *Cultures and organizations: Software of the mind* (2nd ed.). New York, NY: McGraw-Hill.

Holland, D., & Eisenhart, M. (1990). *Educated in romance: Women, achievement, and college culture.* Chicago: University of Chicago.

House, J. D. (1999). The effects of entering characteristics and instructional experiences and student satisfaction and degree completion: An application of the input-environment-outcome assessment model. *International Journal of Media*, *26*(4), 423-434.

Hughes, R. L., & Jones, S. K. (2011). Developing and assessing college student teamwork skills. *New Directions for Institutional Research*, 149, 53-64.

Hunkeler, D., & Sharp, J. E. (1997). Assigning functional groups: The influence of group size, academic record, practical experience, and learning style. *Journal of Engineering Education, 86,* 321-332.

Ishiyama, J. (2002). Does early participation in undergraduate research benefit social science and humanities students? *College Student Journal, 36*(3), 380-386.

Johnson, D. W., & Johnson, R. T. (1992). *Positive interdependence: Activity Manual and Guide*. Edina, MN: Interaction Book.

Johnson, D. W., & Johnson, R. T. (2009). An educational psychology success story: Social interdependence learning theory and cooperative learning. *Educational Researcher, 38(5),* 365-379.

Johnson, D. W., Johnson, R. T., & Smith, K. A. (1991). Cooperative learning: Increasing college faculty instructional productivity. *ASHE-ERIC Higher Education Report No. 4*. Washington, DC: The George Washington University, School of Education and Human Development.

Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research*, 1 (2), 112-133.

Kelly, L. J. (1996, May). *Implementing Astin's I-E-O model in the study of student retention: A multivariate time dependent approach*. Paper presented at the 36th Annual Form of the Association for Institutional Research, Albuquerque, NM.

Kezar, A. J. (1999). *Higher education trends (1997-1999): Faculty.* Washington, DC: The George Washington University. Graduate School of Education and Human Development.

Kezar, A. J. , & Moriarty, D. (2000). Expanding our understanding of student leadership development: A study exploring gender and ethnic identity. *Journal of College Student Development, 41*(1), 55-69.

Kezar, A. J., Chambers, T. C., & Burkhardt, J. (2005). *Higher education for the public good: Emerging voices from a national movement*. San Francisco, CA: Jossey-Bass.

Kim, M. M. (1995). *Organizational effectiveness of women-only colleges: The impact of college environment on students' intellectual and ethical development.* Doctoral dissertation, University of California, Los Angeles.

Kim, M. M. (2002). Cultivating intellectual development: Comparing women-only colleges and coeducational colleges for educational effectiveness. *Research in Higher Education, 43*(4), 447-481.

Kim, Y. K., & Sax, L. J. (2007). Different patterns of student-faculty interactions in research universities: An analysis by student gender, race, SES, and first-generation status. A student experience in the research university (SERU) project research paper. *Research & Occasional Paper Series*: CSHE.10.

Kim, Y. K., & Sax, L. J. (2009). Student-faculty interactions in research universities: Differences by student gender, race, social class, and first-generation status. *Research in Higher Education, 50*(5), 437-459.

King, A. (1994). Guiding knowledge construction in the classroom: Effects of teaching children how to question and explain. *American Educational Research Journal, 31(2),* 338-368.

King, A. (1999). Discourse patterns for mediating peer learning. In A.M. O'Donnell & A. King (Eds.), *Cognitive Perspectives on Peer Learning* (pp. 87-115). Mahwah, NJ: Lawrence Erlbaum.

King, P., Wood, P., & Mines, R. (1990). Critical thinking among college and graduate students. *Review of Higher Education, 13*(2), 167-186.

Kinlaw, D. C. (1991). *Developing superior work teams: Building quality and the competitive edge.* San Diego, CA: Lexington.

Kitchener, K., Wood, P., & Jensen, L. (1999, August). *Curricular, co-curricular, and institutional influence on real-world problem-solving*. Paper presented at the meeting of the American Psychological Association, Boston, MA.

Kneser, C., & Ploetzner, R. (2001). Collaboration on the basis of complementary domain knowledge: Observed dialogue structures and their relation to learning success. *Learning and Instruction, 11*, 53-83.

Knight, W. E. (1994a, May-June). *Influences on the academic, career, and personal gains and satisfaction of community college students*. Paper presented at the 34th Annual Forum of the Association for Institutional Research, New Orleans, LA.

Knight, W. E. (1994b, May-June). *Why the five-year (or longer) bachelors degree? An exploratory study of time to degree attainment*. Paper presented at the 34th Annual Forum of the Association for Institutional Research, New Orleans, LA

Kogut B., & Zander U. (1992) Knowledge of the firm, combinative capabilities, and the replication of technology, *Organization Science, 3*(3) 383-397.

Kozlowski, S. W. J., & Bell, B. S. (2003). Work groups and teams in organizations. In W. C. Borman, D. R. Ilgen, & R. J. Klimoski (Eds). *Handbook of Psychology: Industrial and Organizational Pscyhology* (pp. 333-376). Hoboken, NJ: Wiley.

Kuh, G. D. (1995). The other curriculum: Out-of-class experiences associated with student learning and personal development. *The Journal of Higher Education*, *66*(2), 123-155.

Kuh, G., & Hu, S. (1999, April). *Learning productivity at research universities*. Paper presented at the meeting of the American Educational Research Association, Montreal, Canada.

Kuh, G. D., & Hu, S. (2001). The effects of student-faculty interaction in the 1990s. *The Review of Higher Education, 24*(3), 309-332.

Kuh, G. D., Kinzie, J., Schuh, J. H., & Whitt, E. J. (2010). *Student success in college*. San Francisco, CA: John Wiley & Sons.

Kuh, G. D., Nelson Laird, T. F., & Umbach, P. D. (2004). Aligning faculty activities and student behavior: Realizing the promise of greater expectations. *Liberal Education, 90*(4), 24–31.

Kuh, G. D., Pace, C. R., & Vesper, N. (1997). The development of process indicators to estimate student gains associated with good practices in undergraduate education. *Research in Higher Education, 38,* 435-454.

Lau, L. K. (2003). Institutional factors affecting student retention. *Education, 124*(1), 126-136.

Larson, J. R., & Christensen, C. (1993). Groups as problem-solving units: Toward a new meaning of social cognition. *British Journal of Social Psychology, 32,* 5-30.

Lee, V. E., & Marks, H. M. (1990). Sustained effects of the single-sex secondary school experience on attitudes, behaviors, and values in college. *Journal of Educational Psychology, 82*(3), 578-592.

Leskes, A., & Miller, R. (2006). *Purposeful pathways: Helping students achieve key learning outcomes*. Washington, DC: Association of American Colleges & Universities.

Leppel, K. (2001). The impact of major on college persistence among freshmen. *Higher Education, 41,* 327-342.

Levine, J. M., & Resnick, L. B. (1993). Social Foundations of Cognition. *Annual Review of Psychology, 44,* 585-612.

Lewis, D. R., & Hearn, J. (2003). *The public research university: Serving the public good in new times*. Lanham, MD: University Press of America.

Li, G., Long, S., & Simpson, M. E. (1998, March). *Self-perceived gains in communication and critical thinking skills: Are there disciplinary differences?* Paper presented at the meeting of the Association for Institutional Research, Minneapolis, MN.

Li, G., Long, S., & Simpson, M. E. (1999). Self-perceived gains in critical thinking and communication skills: Are there disciplinary differences. *Research in Higher Education, 40*(1), 43-60.

Little, R. J. A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association, 83*(4), 1198-1202.

Long, P. N. (1993, November). *A study of underprepared students at one community college: Assessing the impact of student and institutional input, environmental, and output variables on student success*. Paper presented at the 18th Annual Meeting of the Association for the Study of Higher Education, Pittsburgh, PA.

Lundberg, C. A., & Schreiner, L. A. (2004). Quality and frequency of faculty-student interaction as predictors of learning: An analysis of student race/ethnicity. *Journal of College Student Development, 45*(5), 549-565.

Martin, L., & Clark, L. (1990). Social cognition: Exploring the mental processes involved in human social interaction. In M. W. Eysenck (Ed.), Cognitive Psychology: An international review (pp. 195–216). Hillsdale, NJ: Willey.

Mayo, J. R., Murguía, E., & Padilla, R. V. (1995). Social integration and academic performance among minority university students. *Journal of College Student Development, 36*(6), 542-552.

Menges, R. (2000). Shortcomings of research on evaluating and improving teaching in higher education. In K.E. Ryna (Ed.), *Evaluating teaching in higher education: A vision for the*

future (pp. 5-11). San Francisco, CA: Jossey-Bass.

Morgeson, F. P., DeRue, D. S., & Karam, E. P. (2010). Leadership in teams: A functional approach to understanding leadership structures and processes. *Journal of Management, 36*(1), 5-39.

Morgeson, F. P., Reider, M. H., & Campion, M. A. (2005). Selecting individuals in team settings: The importance of social skills, personality characteristics, and teamwork knowledge. *Personnel Psychology, 58*(3), 583-611.

Myers, R. (1990). *Classical and modern regression with applications* (2nd ed.). Boston, MA: Duxbury Press.

Nelson Laird, T. F. (2005). College students' experiences with diversity and their effects on academic self-confidence, social agency, and disposition toward critical thinking. *Research in Higher Education, 46*, 365-387.

Newman, P. R., & Newman, B. M. (1976). Early adolescence and its conflict: Group identity versus alienation, *Adolescence, 11*(42), 261-274.

Nunnally, J. C. (1978). *Psychometric Theory* (2nd ed.). New York, NY: McGraw Hill.

Obama, B. H. (2009, April 24). "Remarks by the President on higher education" . Retrieved July 15, 2014, from http://www.whitehouse.gov/the_press_office/Remarks-by-the-President-on-Higher-Education.

O'Donnell, A. M., & King, A. (Eds.). (1999). *Cognitive perspectives on peer learning*. Mahwah, NJ: Lawrence Erlbaum.

Ormrod, J. (2004). *Human learning*. Upper Saddle River, NJ: Pearson Education.

Osborne, J. W, & Waters, E. (2002). Four assumptions of multiple regression that researchers should always test. *Practical Assessment, Research, and Evaluation, 8*(2), 1-5.

Padgett, R. D., Goodman, K. M., Johnson, M. P., Saichaie, K., Umbach, P. D., & Pascarella, E. T. (2010). The impact of college student socialization, social class, and race on need for cognition. *New Directions for Institutional Research (no.145) - Diversity and educational benefits: Expanding the scope, deepening our understanding* (pp. 99-111). San Francisco, CA: Jossey-Bass.

Padgett, R. D., Johnson, M. P., & Pascarella, E. T. (2012). First-generation undergraduate students and the impacts of the first year of college: Some additional evidence. *Journal of College Student Development, 53*(2), 243-266.

Palinscar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension monitoring activities. *Cognition and Instruction, 1,* 117–175.

Pascarella, E. T. (1976). Perceptions of the college environment by students in different academic majors in two colleges of arts and sciences. *Research in Higher Education, 4*(2), 165-176.

Pascarella, E. T. (1980). Student-faculty informal contact and college outcomes. *Review of Educational Research, 50*(4), 545-595.

Pascarella, E. T. (1985a). College environmental influences on learning and cognitive development: A critical review and synthesis. In J. C. Smart (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 1, pp. 1-61). New York, NY: Agathon.

Pascarella, E. T. (1985b). Students' affective development within the college environment. *The Journal of Higher Education, 56*(6), 640-663.

Pascarella, E. T. (2001). Identifying excellence in undergraduate education: Are we even close? *Change, 33*(3), 19-23.

Pascarella, E. T. (2006). How college affects students: Ten directions for future research. *Journal of College Student Development, 47*(5), 508-520.

Pascarella, E. T., Hagedorn, L. S., Whitt, E. J., Yeager, P. M., Edison, M. I., Terenzini, P. T., & Nora, A. (1997). Women's perceptions of a "chilly climate" and their cognitive outcomes during the first year of college. *Journal of College Student Development, 38*, 109-24.

Pascarella, E. T., & Terenzini, P. T. (1976). Informal interaction with faculty and freshman ratings of academic and nonacademic experience of college. *Journal of Educational Research, 70*, 35-41.

Pascarella, E. T., & Terenzini, P. (1991). *How college affects students: Findings and insights from twenty years of research.* San Francisco, CA: Jossey-Bass.

Pascarella, E. T., & Terenzini, P. (2005). *How college affects students: A third decade of research*. San Francisco, CA: Jossey-Bass.

Patel, V. L., Kaufman, D. R., & Arocha, J. F. (1995). Steering through the murky water of a scientific conflict: situated and symbolic models of clinical cognition. *Artificial Intelligence in Medicine, 7*, 413-438.

Pedhazur, E. J., (1997). *Multiple regression in behavioral research* (3rd ed.). Orlando, FL:Harcourt Brace.

Pentland, B. (1995). Information Systems and Organizational Learning: The Social Epistemology of Organizational Knowledge Systems. *Accounting, Management and Information Technologies, 5*(1), 1-21.

Pike, G. R. (1991). Using structural equation models with latent variables to study student growth and development. *Research in Higher Education, 32*(5), 499-524.

Pike, G. R. (1992). Using mixed-effect structural equation models to study student growth and development. *Review of Higher Education, 15*(2), 151-177.

Pike, G. R. (1995). The relationship between self reports of college experiences and achievement test scores. *Research in Higher Edcuation, 67,* 174-195.

Pike, G. R., & Killian, T. (2001). Reported gains in student learning: Do academic disciplines make a difference? *Research in Higher Education, 42,* 117-139.

Pintrich, P. R., Cross, D. R., Kozma, R. B., & McKeachie, W. J. (1986). Instructional Psychology. *Annual Review of Psychology, 37*(1), 611-651.

Posner, M. I. (1996). *Foundations of Cognitive Science* (5th ed.). Cambridge, MA: MIT Press.

Ramaley, J., & Leskes, A. (2002). *Greater Expectations: A new vision for learning as a nation goes to college*. Washington, DC: Association of American Colleges and Universities.

Reitman, W. R. (1965). *Cognition and thought: An information processing approach*. New York, NY: Wiley.

Renn, K. A., & Reason, R. D. (2013*). College students in the United States: Characteristics, experiences, and outcomes*. San Francisco, CA: Jossey-Bass.

Roschelle, J. (1992). Learning by collaborating: Convergent conceptual change. *The Journal of the Learning Sciences, 2(3),* 235-276.

Roschelle, J., & Teasley S. D. (1995). The construction of shared knowledge in collaborative problem solving. In C. E. O'Malley (Ed). *Computer-Supported Collaborative Learning* (pp. 69-197). Berlin, Germany: Springer.

Rosenshine, B., & Meister, C. (1994). Reciprocal teaching: A review of the research. *Review of Educational Research*, 64, 479–530.

Rosser, S. V. (1998). Group work in science, engineering, and mathematics: Consequences of ignoring gender and race. *College Teaching, 46*(3), 82-88.

Sahbaz, S., Culver, S. M., & Burge, P. L. (2014, February*). Supporting students in developing collaborative learning skills in college classrooms.* Paper presented at the Annual Conference on Higher Education Pedagogy, Blacksburg, VA.

Salomone, R. C. (2003). *Same, different, equal: Rethinking single-sex schooling*. Kirkwood, NY: Vail-Ballou.

Sandler, B., Silverberg, L., & Hall, R. (1996). *The chilly classroom climate: A guide to improve the education of women*. Washington, DC: National Association for Women in Education.

Sax, K. (1996). The dynamics of "tokenism": How college students are affected by the proportion of women in their major. *Research in Higher Education*, 37, 389-425.

Sax, L. J. (2008). *The gender gap in college: Maximizing the developmental potential of women and men.* San Francisco, CA: Jossey-Bass.

Sax, L. J., Bryant, A. N., & Harper, C. E. (2005). The differential effects of student-faculty interaction on college outcomes for women and men. *Journal of College Student Development, 46*(6), 642-659.

Schultz, J. L. (1990). Cooperative learning: Refining the process. *Educational Leadership, 47,* 43-45.

Schlotzhauer, S. D. (2007). *Elementary statistics using JMP*. Cary, NC: SAS Press.

Schunk, D. H. (1992). Theory and research on student perceptions in the classroom. In D. H. Schunk, & J. L. Meece (Eds.), *Student perceptions in the classroom* (pp. 3-23). Hillsdale, NJ: Lawrence Erlbaum.

Schwarz, N. (1995). Social cognition: Information accessibility and use in social judgment. In E. Smith, & D. Osherson (Eds.), *Thinking* (pp.345– 376). Cambridge, MA: MIT Press.

Seymour, E., & Hewitt, N. (1997). *Talking about learning: Why undergraduates leave the sciences.* Boulder, CO: Westview.

Shirouzu, H., Miyake, N., & Masukawa, H. (2002). Cognitively active externalization for situated reflection. *Cognitive Science 26,* 469-501.

Shuell, T. J. (1986). Cognitive Conceptions of Learning. *Review of Educational Research,* 56: 411-436.

Slavin, R. E. (1995a). Enhancing intergroup relations in schools: Cooperative learning and other strategies. In W. D. Hawley & A. W. Wells (Eds.), *Toward a common destiny: Improving race and ethnic relations in America* (pp. 291-314). San Francisco, CA: Jossey-Bass.

Slavin, R. E. (1995b). *Cooperative learning*. Needham Height, MA: Allyn & Bacon.

Smart, J., Feldman, K., & Ethington, C. (2000). *Academic disciplines: Holland's theory and the study of college studetns and faculty*. Nashville, TN: Vanderbilt University.

Smith, D., Morrison, D., & Wolf, L. (1994). College as a gendered experience: An empirical analysis using multiple lenses. *Journal of Higher Education,* 65, 690-720.

So, H. J., & Brush, T. A. (2008). Student perceptions of collaborative learning, social presence and satisfication in a blended learning environment: Relationships and critical factors. *Computers & Education, 51*(1), 318-336.

Sorcinelli, M. D. (1991). Research findings on the seven principles. *New Directions for Teaching and Learning, 47,* 13-23.

Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of educational research, 69*(1), 21-51.

St. John, E. P. (2003). *Refinancing the college dream: Access, equal opportunity, and justice for taxpayers*. Baltimore, MD: John Hopkins University.

Stevens, J. P. (2002). *Applied multivariate statistics for the social sciences* (4th ed.). Hillsdale, NJ: Erlbaum.

Stevens, M. J., & Campion, M. A. (1994). The knowledge, skill, and ability requirements for teamwork: Implications for human resource management. *Journal of Management, 20*(2), 503-530.

Summers, J. J., Beretvas, S. N., Svinicki, M. D., & Gorin J. S. (2005). Evaluating collaborative learning and community. *The Journal of Experimental Education, 73*(3), 165-188.

Tabachnick, B. G., & Fidell, L. S. (1996). *Using multivariate statistics (*3rd ed.*)*. New York, NY: Harper Collins.

Takahira, S., Goodings, D., & Byrnes, J. (1998). Retention and performance of male and female engineering students: An examination of academic and environmental variables. *Journal of Engineering Education*, 87, 1-8.

Teasley, S. D., & Roschelle, J. (1993). Constructing a joint problem space: The computer as a tool for sharing knowledge. In S. P. Lajoie & S. D. Derry (Eds.), *Computers as Cognitive Tools* (pp. 229-258). Hillsdale, NJ: Lawrence Erlbaum.

Terenzini, P. T., & Reason, R. D. (2005, November). *Parsing the first year of college: A conceptual framework for studying college impacts*. Paper presented at the Annual Meeting of the Association for the Study of Higher Education, Philadelphia, PA.

Terenzini, P. T., Springer, L., Yaeger, P., Pascarella, E., & Nora, A. (1994, November). *The multiple influences on students' critical thinking skills*. Paper presented at the meeting of the Association for the Study of Higher Education, Orlando, FL.

Thompson, M. D. (2001). Informal student-faculty interaction: Its relationship to educational gains in science and mathematics among community college students. *Community College Review*, *29*(1), 35-57.

Tierney, W. G., Corwin, Z. B., & Colyar, J. E. (2005). *Preparing for college: Nine elements of effective outreach.* Albany, NY: SUNY.

Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research, 45*(1), 89-125.

Tinto, V. (1987). *Leaving college: Rethinking the causes and curses of student attrition*. Chicago, IL: University of Chicago.

Tinto, V. (1993). *Leaving college: Rethinking the causes and curses of student attrition* (2nd ed.). Chicago, IL: University of Chicago.

Tsui, L. (1999). Courses and instruction affecting critical thinking. *Research in Higher Education*, 40, 185-200.

Tucker, M. L., Powell, K. S., & Meyer, G. D. (1995). Qualitative research in business communication: A review and analysis. *Journal of Business Communication, 32*(4), 383-399.

Umbach, P. D., & Wawrzynski, M. R. (2005). Faculty do matter: The role of college faculty in student learning and engagement. *Research in Higher Education, 46*(2), 153-184.

Varney, G. H. (1989). *Building productive teams: An action guide and resource book*. San Francisco, CA: Jossey-Bass.

Volkwein, J. F. (1991, November). *Improved measures of academic and social integration and their association with ten educational outcomes*. Paper presented at the meeting of the Association for the Study of Higher Education, Boston, MA.

Volkwein, J. F., & Carbone, D. (1994). The impact of departmental research and teaching climates on undergraduate growth and satisfaction. *Journal of Higher Education*, 65, 147-167.

Volkwein, J. F., King, M. C., & Terenzini, P. T. (1986). Student-faculty relationships and intellectual growth among transfer students. *The Journal of Higher Education, 57*(4), 413-430.

Vygotsky, L. S. (1978). *Mind and society: The development of higher psychological processes*. Cambridge, MA: Harvard University.

Watson, L., & Kuh, G. D. (1996). The influence of dominant race environments on student involvement, perceptions, and educational gains: A look at historically black and predominantly white liberal arts institutions. *Journal of College Student Development*, *37*(4), 415-424.

Webb, N. M. (1989). Peer interaction and learning in small groups. *International Journal of Educational Research*, 13, 21–39.

Webb, N. M. (1991). Task-related verbal interaction and mathematics learning in small groups. *Journal for Research in Mathematics Education*, *22*(5), 366-389.

Webb, N. M., & Palincsar, A. S. (1996). Group processes in the classroom. In D. C. Berliner (Ed.), *Handbook of educational psychology* (pp. 841–873). New York, NY: Macmillan.

Weidman, J. (1989). Undergraduate socialization: A conceptual approach. In J. Smart

(Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 5, pp. 289-322). New York, NY: Agathon.

Whitmire, E., & Lawrence, J. (1996, November). *Undergraduate students' development of critical thinking skills: An institutional and disciplinary analysis and comparison with academic library use and other measures*. Paper presented at the meeting of the Association for the Study of Higher Education, Memphis, TN.

Whitt, E. J, Edison, M., Pascarella, E. T., Nora, A., & Terenzini, P. T (1999a). Women's perceptions of a" chilly climate" and their cognitive outcomes in college: Additional evidence. *Journal of College Student Development, 40*, 163-177.

Whitt, E. J., Edison, M., Pascarella, E. T., Nora, A., & Terenzini, P. T. (1999b). Interactions with peers and objective and self-reported cognitive outcomes across three years of college. *Journal of College Student Development, 40*(1), 61-78.

Whitt, E., Pascarella, E., Pierson, C., Elkins, B., & Marth, B. (2006). *Sex and gender in college: Evidence of differences in experiences and outcomes*. Nashville, TN: Vanderbilt University.

Williams, D. (1990). Is the postsecondary classroom a chilly one for women? A review of the literature. *Canadian Journal of Higher Education, 20*(3), 29-42.

Zhang, Z., & RiCharde, R. S. (1998, April). *Assessing college students' development: A repeated measures analysis using mixed model.* Paper presented at the meeting of American Educational Research Association, San Diego, CA.

Zimmerman, B. J. (2006). Development and adaptation of expertise: The role of regulatory

processes and beliefs. In K. A. Ericson, N. Charness, & R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 705-722). New York, NY: Cambridge University.

Zimmerman, B. J., & Kitsantas, A. (2005). The hidden dimension of personal competence: Self-regulated learning and practice. In A. J. Elliot, C. S. Dweck & M. V. Covington (Eds.), *Handbook of Competence and Motivation* (pp. 509-526). New York, NY: Guilford.

Zusho, A., Pintrich, P. R., & Coppola, B. P. (2003). Skill and will: The role of motivation and cognition in the learning of college chemistry. *International Journal of Science Education, 25*(9), 1081-1094.

Appendix A

The University's Academic Areas as Classified by Biglan's Model (1973)

Hard Pure Academic Areas	Hard Applied Academic Areas
Agricultural Sciences	Aerospace Engineering
Animal and Poultry Sciences	Agricultural and Applied Economics
Biochemistry	Biological Systems Engineering
Biological Sciences	Chemical Engineering
Chemistry	Civil Engineering
Computer Science	Computer Engineering
Crop and Soil Environmental Sciences	Construction Engineering and Management
Dairy Science	Electrical Engineering
Engineering Science and Mechanics	Engineering Science and Mechanics
Environmental Science	Business Information Technology
Fisheries Science	Industrial and Systems Engineering
Food Science and Technology	Materials Science and Engineering
Forestry	Mechanical Engineering
Geography	Mining Engineering
Geosciences	Ocean Engineering
Horticulture	Statistics
Natural Resources Conservation	
Physics	
Mathematics	
Wildlife Sciences	
Wood Science and Forest Products	
Soft Pure Academic Areas	**Soft Applied Academic Areas**
Communication	Accounting and Information Systems
English	Apparel, Housing, and Resource Management
Foreign Language-Classical Studies	Applied Economic Management
Foreign Language-French	Architecture
Foreign Language-German	Art
Foreign Language-Spanish	Economics
History	Finance
Human Development	Industrial Design
Human Nutrition, Foods, and Exercise	Interior Design
Humanities, Science and Environment	International Studies
Interdisciplinary Studies	Landscape Architecture
Philosophy	Management
Political Science	Marketing
Psychology	Music
Public and Urban Affairs	Theater Arts
Religion and Culture	
Sociology	