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A Business School Living Learning Community: A Complexity Theory Study of Collaborative Engagement Using Network Analysis

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A BUSINESS SCHOOL LIVING LEARNING COMMUNITY: A COMPLEXITY THEORY STUDY OF COLLABORATIVE ENGAGEMENT USING NETWORK ANALYSIS

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ABSTRACT

As funding for institutions of higher education becomes tighter, state and federal entities have turned to student retention and graduation rates as measures of success to determine levels of financial support. A concept, supported by student development theories, used to increase retention and graduation rates is creating living learning communities (LLCs). Researchers previously concluded that student participation in an LLC positively affects student academic performance, engagement, and retention.

The purpose of this study was to investigate how networks developed in a living learning community and what, if any, network variables contributed to academic performance. Specifically, dynamic network analysis using ORA software provided network statistics to determine how network density, component statistics, and cliques developed over the course of the semester. Additionally, ORA software determined social, advice, and study network Newman groupings to study how clusters of students developed during the semester. Finally, a regression analysis using JMP software and ORA derived network measures was accomplished to determine what network variables contributed to positive academic performance.

Results found students who are well connected are likely to have better GPAs and consequently higher retention rates than students who are not well connected in the network. It was also interesting to note that residence hall living configurations restricted networking among LLC participants. Specifically, networking did not seem to take place between resident hall occupants who lived on different floors in the residence hall.

Practitioners should schedule and promote and students should participate in activities that further network development.

DEDICATION

I would like dedicate this work to my wife who supported and encouraged me to finish this degree. Furthermore, I want to thank my children, their spouses, and grandchildren, who were understanding as I traveled this journey. There were times I was physically there but mentally checked out as I worked on or thought about my research. Thank-you all for your support and understanding. Knowing you were watching to make sure I finished was always in my mind and provided some of the momentum to cross the finish line.

I also want to dedicate this work to my parents. They were tough and firm over the years. While they passed before this work was completed, they were always there in spirit. I know they are beaming with pride from above. I can still hear them saying, "Anything worth doing is worth doing right. Nothing worth doing is ever easy." I hope I did it, and will continue to do it, right.

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study sessions are most memorable. Thanks to those who participated. One never knows who and how friends will assist. Without mentioning names to avoid the fear of leaving someone out, I would be remiss if I did not thank Jon Christiansen for being a great sounding board and friend during this process. He was always full of guidance, advice, and suggestions. Thank-you, my friend.

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CHAPTER I

INTRODUCTION

As funding from federal and state governments to institutions of higher education has become tighter, states have turned to student retention and graduation rates as measures of success and factors for determining funding (Berger and Lyon, 2005; Nora, 1987). At the same time, federal policy initiatives (Morrill Act, GI Bill, Civil Rights Act, financial aid, etc.) have increased access to higher education (Berger and Lyon, 2005). These two factors combined with the rising costs of higher education and the decreased opportunities for institutions to raise tuition (Berger and Lyon, 2005) have resulted in universities examining their student development initiatives.

Key studies in student development began appearing in the late 1960s with the work of Feldman and Newcomb (1969), followed by additional studies in this area conducted by Tinto in 1975, Astin in 1977 and 1985, Kamens in 1974, and Bean in 1980 and 1983 (Berger and Lyon, 2005). The key finding from these and many other studies concluded student involvement influenced both student development and persistence in college (Tinto, 1997). For example, Astin (1999) and Chickering (1975) found that students who lived on-campus persisted at a higher rate than those who did not, and Berger and Milem's (1999) research found early involvement in the fall semester had significant, indirect effects on a student's social and academic integration, institutional commitment, and persistence. Their study plus the one conducted by Tinto (1997) also found that early involvement with faculty increased student perception of institutional support and commitment. In later research Pike (1999) reported that the desire to

leverage on-campus living with enhanced student learning encouraged many institutions to design residence halls to promote both learning and development. Pike's research demonstrated that a residential learning community (RLC) or living learning community (LLC) provides a mechanism for stimulating student involvement, improving faculty-student interaction, and creating a more supportive peer climate.

The concept of an LLC evolved out of such research, with Tinto's (1997) study identifying four effects an LLC has on student persistence. The first impact or conclusion indicates that participation in an LLC helps students develop a support network, one that provides a bonding experience within the social aspects of the institution. Tinto also concluded that the variety of learning experiences provided by an LLC added to the intellectual richness of the college experience. Third, students' intellectual gain and academic performance as measured by their GPAs were greater in LLCs than in traditional learning environments, gains, according to Tinto, occurring regardless of student attributes. Fourth, Tinto found these gains were achieved in settings where student involvement, in this case a non-residential community college, was not easily attained, further supporting the benefits of LLCs on college campuses.

In more recent research Zhao and Kuh (2004) concluded that the living learning community is uniformly and positively linked to student academic performance, engagement in educationally productive activities (i.e.: academic integration, active and collaborative learning, and interaction with faculty members), and overall satisfaction with college. These results further support the conclusions of previous researchers (Astin, 1984; Pascarella and Terenzini, 1991, Rendon, 1994; and Tinto, 1993) who found

students who actively participated in non-classroom related activities are more likely to connect with their affinity group, in this case their LLC. These researchers concluded such participation positively contributes to student retention, success in the classroom (as measured by GPA), and personal development.

According to Tinto (2003), the higher education learning experience can, at times, be considered a spectator sport where most students become isolated learners, their participation primarily passive as the faculty lecture and talk. Based on his research, Tinto identifies three common LLC features designed to address this situation. The first commonality of all LLCs is shared knowledge as these students take similar courses, providing a shared curricular experience. Shared knowing is the second commonality Tinto identifies; enrolling in the same classes means students in the LLC get to know one another quickly in the classroom as well as outside the classroom in the residence halls. As Tinto points out, this shared intellectual and social experience promotes student development. The third and final commonality of LLCs is shared responsibility where the LLC asks students to become responsible to one another in the educational process. In this same study Tinto concludes that these commonalities cause LLC students to form their own self-supporting groups, spend more time together as they learn and socialize, perceive greater intellectual gains over students not involved in an LLC, see themselves as more engaged academically and socially, and, thus, persist at a higher rate than students not involved in an LLC. This research suggests the importance of social network development, one including engagement, information flow, the development of

dyads and Simmelian ties, and access to resources, within an LLC as a key factor in academic achievement and retention.

Problem Statement

Many universities employ LLCs to address these student development findings to increase retention. Since establishing, organizing, and administering LLCs are not cost neutral (events, staffing, etc.), examining these organizations to determine how networks develop within such a community as well as their effectiveness in relation to academic achievement is worth studying. Additionally, studying network development can determine factors that contribute to or detract from successful information flow, providing LLC leadership insight into what does and does not contribute to network development.

Purpose Statement

The purpose of this study evolves from findings by Tinto (1975, 1993, 1997, & 2003) and others that support networks and engagement in academic and social experiences affect such outcomes as GPA and retention. The goal, then, is to understand how networks develop within LLCs and to determine how network independent variables (betweenness, speed, and Simmelian ties) relate to network dependent variables (resources, retention, and academic achievement as measured by student GPA). The mediating resource in this study is access to resources that enable students' experiences during their first year.

The participants in this study primarily consisted of first-semester, freshman pre-business and behavioral science students at a mid-sized, four-year, degree-granting

research university in the southeastern United States. All students at this university wishing to obtain a business degree, defined as a Bachelor of Science Degree in accounting, economics, finance, management, or marketing, begin in a pre-business program. Once a predefined course of study is successfully completed, these students typically change their majors to their desired business academic program. Behavioral Science students at the university studied include anthropology, sociology, psychology, and political science degree seeking students. LLC students who were not business and behavioral science students were matriculating in various other majors in the university.

Research Questions

This quantitative study used Dynamic Network Analysis methodology and statistical modeling to explore how the development of network dynamics in a living learning community influenced academic outcomes/achievements. Specifically, this study investigated the following research questions:

- How did network density, component statistics (isolates, dyads or pairs, triads, and larger groupings), and cliques develop and evolve over the course of the semester?
- What study, social, and advice networks, as identified by Newman Groupings, developed by the end of the semester?
- What ORA-derived network measures predicted positive academic performance when compared to a student's predicted GPA?

The results from this study provide insight into how living learning coordinators and university administrators can foster network development and connections among

students resulting in increased retention and student achievement especially in the early stages of college attendance.

Methodology Overview

To address these questions, the researcher administered a pre- and post- survey to LLC students to determine with whom they interact and study, what resources they used during their first semester, and measures of attitudes about their LLC experience. Dynamic network analysis software (ORA) analyzed the survey data from these first-year students to study network development within the LLC over the course of the student's first semester. This ORA software generates network relationships and the degree of interactions across the network, identifying those students central to the information flow.

Prior to collecting data from the LLC students surveyed, an exploratory questionnaire was administered to the previous year's LLC to determine the most likely answers in order to predetermine participant resident responses to bound the survey answers. ORA requires this definable network to process the network matrices. The responses obtained from this preliminary survey served as the response list for the LLC studied. Following the dynamic network analysis of this LLC, JMP software analyzed the ORA network measures to conduct the hierarchical linear modeling analysis. This analysis determined the predictor variables associated with a positive student academic outcome, defined as when students outperformed their predicted GPAs.

Complexity Theory

Complexity theory, the theoretical framework used in this research, describes the interactive processes between individuals within a dynamic network, specifically,

collaborations, decentralized decision-making, initiative, and leadership. These interactive processes produce creativity, learning, and adaptability, all without centralized control or coordination and without a "heroic" leader (a leader in traditional, non-complex organizations). Complex systems demonstrate four traits not found in other organizations, the first feature being their ability to absorb and process large amounts of information and the second, the network's ability to process information to develop new ideas. The third feature is the ability of complex systems, because they are composed of groups of people, to approach problems from many different viewpoints. Finally, complex systems generate change (Marion & Gonzales, 2014) and productivity (Marion, Christiansen, Klar, Schreiber, & Erdener, in press). The ability to absorb large amounts of information, process this information into new ideas, explore problems from numerous perspectives, and adjust to change are all aspects first-year living learning communities (networks) are designed to assist students achieve as they transition from high school to college.

Study Delimitations

This study is delimited in two ways. First, it is longitudinal over a short time period, with students completing a survey at the beginning and at the end of one college semester. Further research should expand the study to evaluate additional semesters in the life of LLC students. It would be enlightening, for example, to explore network statistics and student academic achievement after their second semester. Additionally, further research could compare the network development and academic achievement of students in an LLC with students not participating in an LLC.

Second, this study is delimited to one living learning community populated primarily by pre-business and behavioral science students. Additional studies should include students in LLCs from other first-year programs.

Definitions of Key Terminology

Two terms require definitions for the purposes of this research. *Persistence* consists of students' actions that allow them to remain at an institution of higher education from start to degree completion (Berger & Lyon, 2005). *Retention* is the ability of an institution of higher education to retain a student from admission through degree completion.

Dissertation Organization

This study consists of five chapters. The first chapter identifies the research problem and questions as well as outlining the methodology for collecting and analyzing the data to address these research questions. Chapter 2 provides an extensive literature review focusing on networks, network characteristics, and living learning communities. The third chapter identifies the methodology used for the research, and Chapter 4 presents the study findings. Finally, the last chapter identifies the research conclusions and the implications of this study for students, practitioners, and scholars.

CHAPTER II

LITERATURE REVIEW

As early as 1925, Alexander Meiklejohn published an article introducing a reform initiative for higher education. One of his goals included developing a campus with close relationships between faculty and students (Meiklejohn, 1925). His vision included a small college of no more than 35 teachers and 300 students with academic study consisting of a two-year unified curriculum instead of individual topics or disciplines. Additionally, faculty would take on more of a tutorial role instead of the traditional faculty-teacher separation of duties. Meiklejohn (1925) described this relationship between a teacher and student as a coequal partnership requiring students to take responsibility for their learning. In his vision, faculty guided five or six students through all their studies, not just one particular class.

In 1927 Meiklejohn implemented this experimental college at the University of Wisconsin. In this experiment, he established a two-year program focused on interdisciplinary studies with teachers, called "advisors," who conducted weekly tutoring sessions with individual students as well as delivered lectures voluntarily attended by the students (Meiklejohn, 1932). Upon successful completion of this program, students would either complete their degrees at the University of Wisconsin or transfer to other institutions to complete their bachelor's degree.

The first class consisted of all 119 male students who applied to the program. This program was limited to male students because the only residence hall available for the study was a male dormitory. Living arrangements included sections of housing for 30

students, two advisors, and a resident fellow. This arrangement contributed to the small, close-knit ties Meiklejohn sought for educational reform. When this first experimental class graduated, many students transferred to prestigious institutions such as Harvard, Yale, Princeton, Columbia, Brown, Northwestern, and Duke, indicating the experiment had succeeded (Nelson, 2001).

In 1954, Newcomb (1961) initiated another early exploration of a living learning community (LLC), for two consecutive years studying two groups of 17 men who lived in a fraternity-like environment at the University of Michigan. The researcher went to great lengths to ensure the participants, who were all transfer students, were complete strangers to one another. The purpose of Newcomb's research was to improve the understanding of the development of stable interpersonal relationships.

Newcomb (1961) accomplished his work by examining possible attitude changes by administering periodic surveys on a wide range of topics during the time the students lived together. Using rank order correlations (rho), his research found individual attitudes changed very little when related to attraction between students. Additionally, as individuals learned more about others in the house, attractions changed to align more favorably with those with similar attitudes. Newcomb identified three elements of individual systems as attraction, attitudes, and perceived orientations of others. Of these elements, only attraction and perceived orientation changed significantly.

The purpose of this chapter is to provide an understanding of the literature associated with the topics related to this research. Specifically, this chapter provides background information to contextualize the following research questions:

- How did network density, component statistics (isolates, dyads or pairs, triads, and larger groupings), and cliques develop and evolve over the course of the semester?
- What study, social, and advice networks, as identified by Newman groupings, developed over the course of the semester?
- What ORA-derived network parameters predicted positive academic performance when compared to a student's predicted GPA?

Student Development Theories

Key student development research on began in the late 1960s with Feldman and Newcomb (1969), followed by Tinto (1975), Astin (1977; 1985), Kamens (1974), and Bean (1980; 1983). These works address retention issues with a focus on how students develop during their college years. This portion of the literature review introduces the four families of student development theory as described by Long (2012). It then concentrates on the student development theory that is the focus of this research – the environmental interactive family of student development theory. By understanding these four families, practitioners can determine how to use the results of this study to improve student academic performance and retention.

Long (2012) identified, defined, and categorized student development theories into four broad families. His first family, identified as psychosocial student development, describes how students grow and develop over their lives (Long, 2012). The second family Long (2012) identifies is cognitive-structural theories. This family focuses on how students think, reason, organize, and make meaning or interpret their life

experiences. The third family, humanistic-existential theories, explains how students make decisions affecting themselves and others (Long, 2012). The final student development theory is person-environment interactive theories (Long, 2012). As a whole, this family of theories looks at how students' educational environments directly affect their behavior and growth. Understanding these theories enables practitioners to place LLC student networks in context with the changes students are experiencing in college, meaning they will be able to apply the results from this research to enhance students' college experiences, thereby increasing their academic performance and retention.

Psychosocial Student Development Theory

Chickering's "seven vectors" theory of identity development is the most widely used theory in this family of student development (Long, 2012). Initially developed in 1969 and revised in 1993, Chickering (1969) suggests student identity development is foremost during the college years. According to later research conducted by Evans, Forney, and Guido-DiBrito (1998), students move through these vectors fluidly, interacting between and building on them throughout college. The first vector, developing competence, is associated with the students' ability to develop confidence in their ability to achieve goals (Chickering, 1969). The three components of this vector include intellectual competence, physical and manual skills, and interpersonal competence.

Managing emotions, Chickering's (1969) second vector, concerns the students' ability to recognize, accept, express, and control their emotions. Moving through autonomy towards interdependence is his third vector. Here students find increased emotional independence, develop instrumental independence, recognize and accept the importance of interdependence, and become aware of their own interconnectedness with others. Closely related to this vector, students develop mature interpersonal relationships in the next vector (Chickering, 1969) by developing intercultural and interpersonal tolerance for differences and an appreciation for differences, while developing intimate relationships with partners and friends (Evans, Forney, & Guido-DiBrito, 1998).

Building on the previous vectors, Chickering's (1969) theory of student development identifies establishing identity as the fifth vector. In this vector, student identity consists of developing comfort with one's body, appearance, gender and sexual orientation, and social and cultural heritage, forming a clear sense of self-concept and self-esteem. Building further on this vector, students begin to develop the last two vectors – a sense of purpose and integrity (Chickering, 1969). Developing purpose includes setting vocational goals and making commitments to personal interests, activities, and others, while developing integrity consists of establishing values and congruence among these values (Evans, Forney, & Guido-DiBrito, 1998).

Chickering and Reisser (1993) also identified seven environmental factors that affect student development at the collegiate level: institutional objectives, institutional size, student-faculty relationships, curriculum, teaching, friendships and student

communities, and student development programs and services (Evans, Forney, & Guido-DiBrito, 1998). Of these environmental factors, living learning communities enhance student-faculty relationships, friendships and student communities, and student development programs and services. In addition, LLCs reduce institutional size into a smaller, manageable unit. The collegiate environment can further be broken into networks of students, especially students in living learning communities. It is these networks that need further exploration in an attempt to determine what network characteristics or measures can affect student academic performance.

Cognitive-Structural Student Development Theory

Cognitive-structural theories of student development describe how students make meaning out of their experiences. Long (2012) identifies Perry's theory of cognitive development, Kohlberg's theory of moral development, and Park's theory of faith development in this family of student development theories.

Perry's theory of cognitive development. Perry's theory consists of nine positions, which collapse into the following four categories: duality, multiplicity, relativism, and commitment to relativism (Evans, Forney, & Guido-DiBrito, 1998). According to Perry (1970), student development evolves along the continuum of these categories. In the duality or dualism category of Perry's student development theory, students view life in concrete terms of right/wrong, good/bad, success/failure, black/white, for example (Perry, 1970). In this context, students view teachers as the holders of truth, memorizing the facts as presented.

Multiplicity, the next category, recognizes that not everything is known and opinions can be equally sound or valid. Thus, individuals begin to improve their critical and analytical thinking. In Perry's (1970) third category of student development, relativism, not all opinions are necessarily valid and disagreements can occur, while the last category, commitment to relativism involves making choices and decisions (Evans, Forney, & Guido-DiBrito, 1998).

Kohlberg's theory of moral development. This theory consists of three levels of continuing development with two stages in each level. In the first level, called pre-conventional, individuals do not understand societal rules and expectations, viewing life with an individualistic focus (Kohlberg, 1976). In stage one of this level, heteronomous morality, right is seen as obeying rules to avoid punishment and avoiding harm to persons and property (Kohlberg, 1976). Essentially, an individual's morality answers the question, "How can I avoid punishment?" In stage two of the first level, referred to as individualistic/instrumental morality (Kohlberg, 1976); people follow rules only if it is in their best interest to do so, meaning right consists of a previously established agreement based on one's self-interest: "What is in it for me?" (Evans, Forney, & Guido-DiBrito, 1998).

Level two, the conventional level, is characterized by individuals who identify with the rules and expectations of others, especially people in position of authority (Kohlberg, 1976). The first stage of this level, interpersonally normative morality, defines right as living up to the expectations of the people one is close to and behaving in

an acceptable way (Kohlberg, 1976). In this stage, people are looking for the approval of others. The second stage, called social system morality, defines right as obeying societal laws and accomplishing duties as agreed (Kohlberg, 1976).

In the post-conventional or principled level, the third and final level of Kohlberg's theory (Kohlberg, 1976), individuals base decisions on their own principles. The first stage of this level is human rights and social welfare morality (Kohlberg, 1976). Here rightness consists of how individuals promote human rights and values. In the final stage of this level, the morality of universal ethical principles (Kohlberg, 1976), individuals consider everyone's point of view in situations (Evans, Forney, & Guido-DiBrito, 1998). Specific to the research reported here, involvement in living learning communities fosters moral development by placing students in a group and subjecting them to situations where moral judgments occur in the normal course of college life.

Parks' theory of faith development. According to Long (2012), Parks' theory of faith development is the most dominant theory of faith or spiritual development. Faith development is the process of discovering and creating connections between experiences and events and life's meaning (Parks, 2000). Parks wrote that college and university settings can affect faith in a positive or negative way (Parks, 2000; Pascarella & Terenzini, 2005). As Long (2012) explained, student affairs professionals should work to create experiences to promote self-reflection with respect to students' value systems, something that can be accomplished through social events and community service opportunities.

These three cognitive theories, all reflective of students' college years, are influenced during their first real experiences away from home. Social reflection through social activities and community service events conducted in LLCs promote both student and network development. This research explores these aspects of student development by studying these elements from a network perspective by determining what network measures are important in academic achievement and retention.

Humanistic-Existential Student Development Theory

The humanistic-existential theories of student development describe students' relationship to others and society. Concerned with conditions for healthy growth and development, Long (2012) identifies Hettler's model of wellness as the key theory in this family. Hettler (1989) identifies six dimensions of a student's life (physical, intellectual, social/emotional, spiritual, environmental and occupational) that are key to a student's wellness. Balancing these dimensions is critical to a student's ability to take full advantage of the higher educational experience. This research investigated students' involvement in the LLC from a network perspective to determine how their involvement based on academic performance promotes their intellectual development.

Person-Environment Interactive Student Development Theory

Person-environment interactive theories, Long's (2012) last family of student development theories, describes how the college or university environment affects a student's development. The prominent theories in this family include Astin's theory of

student development, Tinto's theory of student departure, and Pascarella's model for assessing student change.

While research has shown that student involvement matters (Astin, 1978, 1985, 1999; Tinto, 1975, 1997; Terenzini & Pascarella, 1977; Mallette & Cabrera, 1991; Berger & Milem, 1999), Pace (1982) adds a qualifier to this well-researched conclusion, stating that the quality of effort in student involvement also matters. For example, students can spend many hours studying, but if they are not applying themselves, their grades do not improve. Studies show living on campus, whether in a dormitory or fraternity or sorority house, matters; however, again, if the student does not put forth quality effort, then the environment does not matter. Pace (1982) makes the same statements with respect to students desiring to further their education in graduate school and time on task.

Astin's theory of student development. Astin (1975) researched student persistence from the perspective of their residential status and their academic achievement and extracurricular activities. The author concluded that students' chances of completing college improved substantially if they leave home and live in a residence hall (Astin 1975, 1978, 1985). This conclusion supported his and other researchers' previous studies showing that dormitory living increases student persistence. Persistence was greater for students living in a dormitory than all but one of the six options studied (college dormitory, with parents, other private home, apartment living, fraternity or sorority house, or other housing). The one option with higher persistence rates than dormitory living was associated with first-year residence in a fraternity or sorority house.

However, Astin (1975) advises caution with this observation because of the low number of freshman students who reside in fraternity and sorority houses.

With respect to a student's academic achievement and extracurricular activities, Astin (1975) concluded that a student's grade point average was the strongest academic experience related to persistence. Additionally, participating in honors programs, study abroad opportunities, and extracurricular activities (especially fraternities and sororities) had favorable impacts on student persistence. Further work demonstrated student satisfaction with their undergraduate experience was higher when students were involved in activities such as fraternities and sororities, interactions with faculty members, research projects, student government and athletic activities (Astin, 1978). Astin (1978) concluded that his research supported the theory that personal involvement in campus life increases student persistence.

Student departure theory. Tinto's (1975) research synthesized past studies, drawing conclusions concerning individual student characteristics, interactions with the college environment, and institutional characteristics with respect to student persistence. Students' individual characteristics developed from factors such as family background, their individual characteristics, past educational experiences, and goal commitment. Specifically, a family's socioeconomic status was inversely related to dropout rates (Tinto, 1975; Mallette and Cabrera, 1991), while more educated parents and a high quality relationship (defined as an open, democratic, supportive, and less conflicting

relationship) between parents and their students were family background factors that increased student persistence.

While family background played a part in student persistence, researchers (Tinto, 1975; Mallette and Cabrera, 1991) determined a student's own ability is more important. Two such measures of ability are standardized tests and past educational experience, with the latter being the more accurate predictor of the two. Past educational experience included either grade point average or class rank and the characteristics of the high school itself (facilities and academic staff). The last and most influential individual student characteristic is the student's own commitment to the college completion goal itself. Nora's (1987) research found that for the Chicano ethnic group at community colleges, institutional and goal commitments affected retention rates. Tinto also maintained that the student's commitment to a college education is a reflection of individual, family, and prior experiences.

The second consideration regarding student higher education dropout rates found in Tinto's (1975) research concerns student interaction within the college environment. This interaction appears in two forms: academic and social integration (Tinto 1975; Terenzini & Pascarella, 1977). Both grade performance and intellectual development measure academic integration, with the former being the most visible reflection of academic development and the latter an inherent reward. Persisting students value their education more than dropouts value their education. Students who voluntarily withdraw from higher education do so because they do not see themselves academically integrating

in the institution or valuing their education with respect to grades attainment or intellectual development.

Persistence may also be a reflection of a student's social integration into the institution (Tinto, 1975). Referred to as "person-role fit" and "interpersonal fit," Rootman (1972) found socialization was a major determinant of voluntary withdrawal. This social integration includes successful encounters with friends, support groups, participation in extracurricular activities, and interaction with college faculty. Research found peer-group associations relate directly to social integration at college while extracurricular activities and faculty interactions are of equal secondary importance (Tinto 1975; Terenzini & Pascarella, 1977).

Research conducted by Terenzizni and Pascarella (1977) as well as by Mallette and Cabrera (1991) concluded students who remained at their institutions reported significantly more interactions with faculty members. Their research provided three implications with respect to faculty interactions, the first suggesting the faculty role appears critical in a student's socialization process. Second, the impact of faculty as socializing agents may have both an affective and cognitive impact for persisting students. Lastly, their research suggests that informal faculty contacts may be as important to students' academic integration as to their social integration.

Researchers also found a relationship between fall and spring semester involvement. Specifically, early involvement in the fall semester positively predicts spring involvement (Berger and Milem, 1999). Additionally, early fall involvement

positively affected Tinto's social and academic integration and institutional commitment as well as retention conclusions (Berger and Milem, 1999). In addition, research also found that students who did not become involved early in the fall tended to stay uninvolved for the year. This lack of involvement led to a perception the institution and their peers were not supportive. As a result, these students did not integrate well into the institution and were not as likely to remain. Additionally, Berger and Milem (1999) found students who were less committed to the institution from initial enrollment were also less likely to become involved, a situation which also negatively impacted retention likelihood.

Institutional characteristics, such as type, quality, student composition, and size, also relate to retention (Tinto, 1975). Tinto summarizes much research when he concludes that four-year, private, and high-quality institutions have lower dropout rates than two-year, public, and lower quality institutions. According to Tinto, retention data based on student composition and student income levels proved to be inconclusive. Supporting Tinto's conclusion, Kamens' (1971) research on retention based on institutional size found that large and prestigious institutions retained students at a higher rate than smaller schools because of their stronger status. He (1971) concluded that larger institutions provided access to a larger variety of professional schools and programs, leading to larger alumni networks and corporate recruiting opportunities, resulting in greater choice and access to post graduation vocations and opportunities.

Astin (1999) developed his student involvement theory in 1984, synthesizing his more than 20 years of research on the subject. Austin (1985 & 1999) defines student involvement as the amount of energy, physical and psychological, students devote to their academic experience. Synthesizing this definition, a highly involved student is one who spends considerable time studying, spends a lot of time on campus, actively participates in student organizations, and frequently interacts with other students and faculty. With respect to this last interaction, Astin (1985) maintains that student interaction with faculty requires highly involved faculty to provide opportunities for it to occur. In this context, Astin defines a highly involved faculty member as one who places significant time and energy on teaching, seeks out student advisees, monitors their progress, participates in departmental and institutional activities, and makes an effort to integrate research and teaching.

Astin's (1985 & 1999) involvement theory is comprised five hypotheses. The first hypothesis states that involvement refers to the investment of physical and psychological energy in various objects or activities. These objects range from generalized (the student experience) to specific (preparing for an exam) items. The second hypothesis states that, regardless of the object or activity, involvement occurs along a wide range (Astin, 1985 & 1999), with different students demonstrating differing levels of involvement with a given object and differing levels between different objects at different times. Astin's (1985 & 1999) third hypothesis is that involvement can be characterized qualitatively (how well students understand assignments) and quantitatively (how many hours spent studying).

Astin's (1985 & 1999) fourth hypothesis asserts that student learning and personal development is directly proportional to the quality and quantity of student involvement. Lastly, the effectiveness of an institution's educational policies and practices directly relates to the ability of those policies and practices to influence students to increase their involvement. Astin (1985 & 1999) believes these last two postulates involving student involvement are the key hypotheses suggesting where educational institutions should direct their energy in order to promote student development and success.

Since publishing these five hypothesizes, academic scholars have conducted research supporting Astin's student involvement postulates. For example, Ory and Braskamp (1988) studied student enrollment in special academic programs (transition and honors programs). Supporting Astin, they concluded these students appeared to receive more for their efforts than did regular students (or non-special academic program students). Active participation in these programs led to greater academic and interpersonal gains than participating in other activities.

In more recent research, Berger and Milem (1999) determined that early involvement was critical to student development. Their research found fall semester involvement predicted spring semester involvement as well as persistence. Additionally, Kuh (1995) reported most scholars investigating the impact of college on students concluded that activities outside the classroom contribute to college outcomes. He determined students who participated in extracurricular activities, lived in dormitories, and interacted with faculty and peers experienced higher retention and reported higher

satisfaction with their college experience. Kuh's (1995) study concluded that not only should institutions encourage students to participate in activities outside the classroom they should also enact policies and practices facilitating their interaction with different groups people outside the classroom in such activities as employment and community affairs.

Student development theory and student departure theory established the foundation for my study. My research focuses and builds on these theories by determining the network measures and interactions that occur within an LLC that contribute to student academic achievement.

Schlossberg's Transition Theory

Of all the student development theories, LLC's are designed to address the issues associated with Schlossberg's (1984) transition theory, which, more specifically, includes a framework to assist counselors in understanding adults in transition. The goal of this research is to develop a methodology to provide the tools necessary to help adults cope with transition (Schlossberg, 1984).

Schlossberg (1981) defined transition as an event or non-event that results in a change in assumptions about oneself and the world that requires a corresponding change in one's behavior, networks of relationships, and new self-perceptions. Based on this definition, clearly students beginning their college careers are individuals in transition. Perception also plays a part since a transition does not occur unless the person perceives something is taking place (Evans, Forney, Guido, Patton, & Renn, 2010).

To understand the meaning a transition has on an individual, it is necessary first to understand which of the three types of transitions—anticipated, unanticipated, and non-event—is being experienced (Goodman, Schlossberg, & Anderson, 2006). According to these researchers, anticipated transitions are events that can be predicted (i.e., graduation), while unanticipated transitions are defined as unpredictable or unscheduled events (i.e., divorce or unexpected death of a loved one) (Goodman, Schlossberg, and Anderson, 2006). Lastly, Goodman, Schlossberg, and Anderson (2006) defined a non-event as when something does not occur that was supposed to occur (i.e., not accepted into the college of choice or not receiving a promotion). Further, they identify the following four groups of non-event transitions: the personal non-event related to personal or individual aspirations, the ripple non-event experienced due to someone else's non-event, the resultant non-event caused by an event, and the delayed non-event caused by the anticipation of a possible event (Goodman, Schlossberg, and Anderson, 2006). Since attending college is typically an expected event in the lives of those planning to do so, the students in this situation are experiencing an anticipated transition.

After determining the type of transition, the context and impact must be identified (Goodman, Schlossberg, & Anderson, 2006), with these researchers defining context as the relationship the individual has with the transition as well as the setting where the transition is occurring. The relationship life arena can be personal, interpersonal, and/or community, with each of these consisting of self, family, health, work, and/or economic settings (Schlossberg, 1984).

Students entering college can experience more than one life arena and more than one setting. For example, a student could prefer not to leave home; the family could have financial difficulties affording college, and students are resetting their interpersonal relationships from a big fish in a little pond to a little fish in a big pond. The intent of an LLC is to reduce as many of these arenas as possible to reduce the stress of the transition.

The extent of the transition defines its impact on the individual's life (Schlossberg, 1984; Goodman, Schlossberg, & Anderson, 2006). Schlossberg (1984) identified the impact of a transition as the most important consideration in understanding the situation. As this impact produces stress, the individual's assets and liabilities mitigate this emotion at the time of the transition. Once again, the intent of an LLC is to provide additional assets to address stress, thus allowing students to focus on the primary task they face – college.

Goodman, Schlossberg, and Anderson (2006) identified the following four major sets of factors that influence an individual's ability to cope with transition: situation, self, support, and strategies (referred to as the four S's). The first "S," situation, refers to what triggered the event or transition (Goodman, Schlossberg, & Anderson, 2006), for example timing. Timing considerations include events that are on time or off time with respect to the individual's social clock or good timing versus bad timing. Other situational factor considerations include determining if the transition is within an individual's control or determining if it changes their roles and, if it does, is this change a gain or a loss. Four additional situational factors include the duration of the transition (permanent, temporary, or undefined), the source or sources of stress, the individual

responsible for the transition, and its effect on the individual's behavior (Evans et al., 2010).

The next "S," self, is divided into two categories. Described by Evans et al. (2010), the first category, personal and demographic characteristics, affects how individuals view their lives. These characteristics include socioeconomic status, gender, age, stage of life, health, and ethnicity or culture. The second category, psychological resources, includes ego development, outlook (optimism and self-efficacy), commitment and values, and spirituality and resiliency (Evans et al., 2010), resources that assist with coping strategies.

The third "S," support, which refers to social support, consists of intimate relationships, family units, networks of friends, and institutions and communities (Evans et al., 2010). And the final "S," strategies, describes the following three coping responses: those that modify the situation, those that control the meaning of the problem, and those that aid in managing stress (Evans et al., 2010).

In many respects the LLC positively addresses the many self-factors, provides an on-site family unit and network of friends, and affords strategies designed to cope with the transition of moving from home to college, supporting that many of the components of Schlossberg's transition theory are directly addressed by student involvement in an LLC. As in the student development theories analyzed here, the network measures from an LLC network are the foundational elements that practitioners can explore to understand how they the positively affect the issues associated with transition theory. My

research intends to determine how network measures contribute to a student's academic performance.

Learning Communities

Research has determined student involvement is the key to persistence, emphasizing that institutions should determine how to best stimulate this involvement. As Astin (1999) and Chickering (1974) found, students who lived on-campus persisted at a higher rate than other students. Berger and Milem's (1999) research found early involvement in the fall semester had significant, indirect effects on a student's social and academic integration, institutional commitment and persistence. Their research also showed early involvement with faculty increased student perception of institutional support and commitment. Moreover, Berger and Milem (1999) also determined that non-involved students in the fall stay uninvolved all year long. Furthermore, Tinto's (1997) research suggested that social membership in the first several weeks of the first-year student may be more important than academic membership in those weeks.

A study conducted by Pascarella et al. (1993) found that students who resided in the campus resident halls made larger critical thinking gains than commuting students, suggesting that on-campus living contributed to areas such as student personal development and retention as well as cognitive and intellectual growth. They challenged student affairs personnel on campus to create programs that directly targeted student learning and cognitive development to take advantage of this finding.

Investigating the response to this challenge, Pike (1999) reported the desire to leverage on-campus living with enhanced student learning encouraged many institutions to form residence halls designed to promote student learning and development. His research demonstrated that a residential learning community (RLC) provided a mechanism for stimulating involvement, improved faculty-student involvement, and offered a more supportive peer climate. A key finding indicated that RLC students experienced significantly higher involvement than students in traditional on-campus housing. However, just living in an RLC does not increase involvement; only activities designed specifically to assist student development accomplished this goal (Pike, 1999).

Tinto's (1997) research resulted in three conclusions relative to learning communities. The first indicated that participation in a learning community helped students develop a support network that aided in their ability to bond to the institution and fully engage in its academic life. This community fulfilled the student's social and academic needs without sacrificing either need (Tinto, 1997; Cabrera et al., 2002). This research also determined that the more students were involved from an academic and social perspective in a shared learning environment that linked them as learners with their peers the more likely they were to invest the time needed to learn. This situation also increased student persistence. Tinto's second conclusion, that students participating in a setting where learning comes from two sources, found their learning experience was richer. Tinto's research also concluded students' perceptions of intellectual gain and actual performance, as measured by their GPRs, were better in the learning community

than in traditional residential halls, a result he found to be independent of student attributes.

Shapiro and Levine (1999) provided two learning community definitions. The first, developed by Gebelnick, MacGregor, Matthews, and Smith (1990), identifies a learning community as a variety of curricular structures linking several courses. This linkage allows students to develop a deeper understanding of course materials with more interaction among other students and instructors associated with the learning community. The second definition describes learning communities as a unit organized along curriculum, career interests, avocations, and residential area (Astin, 1985). According to Astin (1985), this community builds a sense of group identity, cohesiveness, and uniqueness that encourages continuity while integrating curricular and co-curricular experiences in order to address the isolation many students feel while in college.

These researchers determined that LLCs provided a way to increase retention by involving students early with other students as well as faculty and increase academic performance. The question is, what network characteristics or measures within the network contributed to this increased academic performance. The aim of this research is to determine the measures that influence academic achievement.

Living Learning Community Traits

With these definitions in mind, Shapiro and Levine (1999), a National Institute of Education Report (1984), and Laufgraben and Shapiro (2004) identified eight characteristics common to learning communities. First, a learning community organizes students and faculty into smaller groups, with common living spaces and course offerings

tying these small groups together. The second characteristic common to learning communities is that they encourage curriculum integration as a way to tie potentially fragmented general education requirements. Doing so allows students to view courses as part of an integrated learning experience instead of separate requirements necessary for a degree. It also places instructors and students in an increased interdisciplinary challenging and stimulating academic environment (Shapiro & Levine, 1999; National Institute of Education Report, 1984; and Laufgraben & Shapiro, 2004).

The third trait of a learning community is it helps students develop natural academic and social support networks inside and outside the classroom. As Shapiro and Levine (1999) found, this aspect of a learning community allows students to associate with other students who share the same attitudes, values, expectations, and practices. Another trait somewhat linked to the previous trait is that a learning community establishes a setting or environment for learning what it is to be a college student as members in the community learn from one another in a common setting. According to Shapiro and Levine (1999), students in the community seek other community members for academic support and encouragement, reinforcing the attitudes, values, and behaviors needed to succeed and improving attendance, participation, and accountability to one another and their instructors.

The fifth characteristic indicates that LLCs increase faculty interactions, resulting in a highly supportive teaching environment and curriculum co-planning while integrating teaching methods, course content, student work, assessment and technology applications. Another trait of learning communities is the faculty's focus on learning

outcomes. The teaching team determines their goals for the community and for student success, and their plans for assessing student learning (Shapiro & Levine, 1999; National Institute of Education Report, 1984; and Laufgraben & Shapiro, 2004).

The seventh trait is that learning communities focus on student support services (i.e.: academic advising, tutoring, career counseling, and mentoring), thus introducing students to campus resources dedicated to student success. The eighth and final characteristic of a learning community is that the development of innovations as a result of building and maintaining the learning community curriculum usually leads to changes in orientation, placement tests, residence programming, academic advising, and student activities (Shapiro & Levine, 1999; National Institute of Education Report, 1984; and Laufgraben & Shapiro, 2004).

The Case for LLCs

Numerous policy studies have created a persuasive case for implementing learning communities on college campuses (Shapiro and Levine, 1999). The early research in this area includes three longitudinal studies starting with Boyer's 1987 report from the Carnegie Foundation for the Advancement of Teaching. Its key findings emphasize the disjointedness between K-12 schools and institutions of higher education; the division between a liberal arts curriculum and the career-minded orientation of students and parents; the choices faculty must make between research, teaching and their loyalty to their discipline; and the widening gap between academic and student affairs groups on a college campus. Boyer (1987) suggests institutions explore how to connect these pieces, advocating balancing community and individualism, creating an institution

within the college that ties the curriculum and co-curricular activities into a single mission, and designing a curriculum that introduces students to the ties across the curriculum and academic disciplines. Shapiro and Levine's (1999) fundamental characteristics of a learning community address Boyer's suggestions, concluding that this research provided the impetus to experiment with reimaging a student's transition to higher education.

The second longitudinal study discussed in Shapiro and Levine's (1999) work is Astin's (1993) research, which concluded with four findings. The first finding suggests that the number of courses a student completes emphasizing writing, scientific inquiry, and historical analysis directly relates to growth in overall general knowledge. Astin's (1993) second finding asserted that enrolling in interdisciplinary courses and courses emphasizing writing skills combined with active participation through in-class discussion, debate, presentations, and discussions of career plans strongly correlates to critical thinking development. His (1993) third finding concluded that student-oriented faculty and peer socioeconomic status, group projects, and critical review of student writings by instructors influence academic development. Astin's (1993) final finding asserted that leadership and interpersonal skills are correlated with student-to-student interactions and socializing with students from different ethnic groups and the number of writing courses taken. The eight characteristics of a learning community developed by Shapiro and Levine (1999), the National Institute of Education Report (1984), and Laufgraben and Shapiro (2004) relate well to Astin's four findings.

Pascarella and Terenzini's 1991 study is the third longitudinal study discussed by Shapiro and Levine (1999). In their study, the researchers concluded that institutional size does not appear to stand out as a determining factor in student growth although they found that it indirectly influential through the kinds of interpersonal relations and experiences promoted or discouraged. They concluded that reducing the size of large institutions provided opportunities for students to become involved with smaller groups of students. Forming cluster colleges, purposeful housing clusters, architectural redesigns, academic organizations, co-curricular activities, and work-study opportunities are examples of ways of achieving these smaller groups. These findings directly relate to many characteristics of learning communities.

In addition to these three longitudinal studies, Shapiro and Levine (1999) identified five policy studies that provided the basis for transforming institutions of higher education through the creation of learning communities, with the fundamental recommendation common to these studies suggesting organizing students and faculty into small communities. In the first study, a National Institute of Education Report (1984), researchers determined student involvement, high expectations, and assessment were the three critical conditions for student excellence, with student involvement being the most important.

Within student involvement, frequent interaction with faculty and peers is one way students can demonstrate a commitment to learning. Researchers specifically cited providing improved services for first- and second-year students by virtue of establishing learning communities organized around specific intellectually related themes. This report

identified six characteristics of an effective learning community, specifically forming groups smaller than most groups on campus, having a sense of purpose, providing opportunities for connecting faculty with their students, encouraging faculty to relate to one another, encouraging integration of the curriculum, and encouraging a sense of identity, cohesion, and specialness within the community.

Shapiro and Levine's (1999) second policy study identified as the basis for establishing living learning communities is the Kellogg Commission Report (1997). This report recommended land grant universities become student-centered learning communities as a way to address enrollment pressures, increasing numbers of competitors, funding issues, increased costs, and limited institutional flexibility. The Commission defined a learning community as an entity where all activities and responsibilities relate to a common enterprise where the quality of learning is inseparable from the experiences gained from the learning community itself.

The next policy study substantiating the need to establish living learning communities is a joint report from the American Association for Higher Education, American College Personnel Association, and National Association of Student Personnel Administrators (1998). This report called for a shared responsibility for learning between academic and student affairs. This joint task force report presented ten tenets of learning, providing suggestions for strengthening each. The first tenet presented by this task force indicated that learning is essentially making and maintaining contacts, with the authors finding these contacts being accomplished biologically (by using neural networks); mentally (through concepts, ideas, and meanings); and experientially (via interactions

between the mind and the environment). Specifically, learning materials challenge students to draw conclusions by providing stimulating comparisons, exploring relationships, and evaluating different perspectives and solutions (American Association for Higher Education, American College Personnel Association, and National Association of Student Personnel Administrators, 1998). Establishing connections requires faculty to design learning experiences that provide students with alternative views, requires students to solve problems and resolve conflicts, compel students to relate the curriculum with other aspects of the college experience, and provide tailored experiences commensurate with the individual student's circumstances.

The second tenet of learning presented by the task force (1998) asserted that presenting students with a compelling situation that balances challenge and opportunity enhances learning. Students learn when tasked with solving complex, meaningful problems requiring innovative situations. The task force's (1998) third tenet concluded that learning is an active process; a learner builds knowledge while actively participating rather than passively receiving knowledge. In this environment students are directly involved in knowledge discovery, take ownership of their own learning, and transform past knowledge into new knowledge.

The fourth task force (1998) tenet of learning asserted that learning builds cumulatively on previous knowledge by integrating past and present knowledge. The task force authors suggested curriculum should add to prior knowledge through greater and more complex experiences. The task force's (1998) fifth tenet of learning maintained individuals learn when they are linked as colleagues or competitors in the learning

process. Enhanced learning occurs through cooperation because individuals in the group provide different life experiences and perspectives from differing cultures and areas of the world or country.

In addition to a building block approach to learning and the diversity provided by individuals making up the learning community, the task force (1998) suggested in its sixth tenet that education is further enhanced by the educational climate in which learning occurs. This tenet defines the climate as faculty, staff, alumni, employers, and others who contribute to the learning process with a strong sense of community or "family" environment. This sixth task force (1998) tenet of learning relies on the seventh tenet, which recommends providing achievable, high standards with timely feedback regarding progress towards those standards. Based on this tenet, students are encouraged to take risks, learn from mistakes, and constructively comment on other's work.

The eighth tenet of learning suggests that much of a student's learning takes place informally and incidentally outside the classroom (Task Force, 1998), contact that occurs in casual situations with faculty, staff, and peers in many settings. In the ninth tenet, the joint task force states learning requires students to transfer knowledge from one circumstance to others when new information or circumstances are encountered and to learn from other's perspectives. The final tenet asserts that individuals must monitor their own learning by understanding how they best acquire knowledge for themselves (Task Force, 1998). Shapiro and Levine (1999) asserted that small, living learning type communities address all nine of these task force tenets.

Shapiro and Levine (1999) cited Schneider and Shoenberg's 1998 American Association of Colleges and Universities paper as another document supporting living learning communities. In this paper, the researchers asserted that education should develop a student's intellectual capacities rather than focus on specific, limited subject matter. To provide these intellectual capacities, institutions must move to an interdisciplinary approach designed to develop understanding of relationships and tensions among ideas. In their work, Schneider and Shoenberg (1998) concluded that living learning communities already provide the basis for this type of learning.

The last policy study discussed by Shapiro and Levine (1999) is found in the 1998 Boyer Commission discussion of undergraduate education. This report suggests that research conducted at institutions of higher education has made these higher education institutions unique among all institutions of American higher education. The article further stated the best undergraduate research occurred in learning communities, advocating that research universities should develop small communities as a way to strengthen and develop research opportunities.

Shapiro and Levine (1999) summarized these three longitudinal studies and five policy studies, concluding that learning communities are a practical way to address the challenges universities face today. These learning communities address retention, persistence, gains required in critical thinking and writing, and student learning assessments. The key becomes to determine how these occur within an LLC. More specifically, how can practitioners exploit the interactions and networking within an LLC to promote academic success? To address this question, this study aims to determine the

network measures that promote academic achievement so that they can be appropriately leveraged.

Social Networks

The LLC, by its very nature, is a network: students live in the same dormitory, attend some of the same classes, attend social events together, and participate in the same workshops together. As a result, the network is the basis of study in this research. Social networks are a finite set of nodes (actors) tied together by one or more relations (Wasserman & Faust, 1994; Marin & Wellman, 2011). These actors can be discrete individuals, groups, organizations, or societies (Katz, Lazer, Arrow, & Contractor, 2004). A defining feature establishes a tie between the actors in the network. According to Wasserman and Faust (1994), these features or relational ties found in network analysis include evaluations among people (friendships, likes, respect), transfers of material items (business transactions, lending or borrowing items), professional or social associations or affiliations, behavioral interactions (talking or messaging), movement between places or statuses, physical connections, formal relations (organizational or authority), and biological (kinship or descendant).

Wasserman and Faust (1994) further presented four kinds of linkages. The first linkage, a dyad, is a tie between two actors, focusing on their relationship and the ties between them without regard to reciprocation. The next linkage, a triad, involves triples of actors and their associated ties. The third type of linkage is the subgroup, defined as any subset of actors and the ties between them. Finally, Wasserman and Faust (1994) identify the group as the collection of all actors and their ties.

Wellman (1988) developed five principles of network perspectives. The first principle stated that examining the relationships among people within a network instead of examining their attitudes, drives, and demographics best predicts their behaviors. Second, the analysis should focus on the relationships among the nodes instead of the nodes themselves or their intrinsic characteristics (Wellman, 1988). Third, interdependence among nodes is assumed. Fourth, the flow of information and resources depends not only on the relationship between two nodes but also on their relationship with everyone else (Wellman, 1988). Lastly, groups have blurry boundaries, meaning there may be overlapping groups within the network (Wellman, 1988). While the first three principles are inherent in all networks, the last two drive the very nature of an LLC. Students do not take all the same courses as advanced placement credits brought to the university as well as student performance on standardized placement exams result in this difference. As a result, LLC network information flow will depend on relationships and, thus, blur network boundaries, causing these groups within the network to overlap.

In their overview of network theory and small groups, Katz, Lazer, Arrow, and Contractor (2004) presented the family of theories within network perspectives. Many of these theories are also found in LLCs. The first of these five theories is the self-interest paradigm that assumes people form dyad, triad, and group ties to maximize their own personal gains. As Katz, et al. (2004) stated, all actors operate out of their own self-interest.

This theory also addressed the accumulation of social resources in terms of social capital, i.e., the actual or virtual resources accrued through the interaction of individuals or groups of individuals with the intent to share or reap returns on their investment (Katz, et al. (2004). LLCs, designed to group students with like goals, facilitate this theory. In the LLC selected for this research, students are primarily first-semester pre-business students taking common courses with the intent to earn a business degree. As a result, the LLC intends to capitalize on the self-interest paradigm theory for personal as well as group gains.

The second network theory is concerned with social exchange and dependency. Katz, et al. (2004) offer George Homan's theory that people establish ties to exchange valued resources. Whereas the previous self-interest theory is based on individuals maximizing their personal investments, social exchange and dependency are meant to minimize an individual's dependence on others to obtain resources while maximizing the dependence of others on their resources. These dependencies fuse the group. This social exchange and dependency exist within an LLC as students attend events together (football games, community social events, etc.) and study together, a situation that is facilitated by common class schedules.

Mutual interest and collective action are included in the third principle of networks. According to this principle, actors in a network create ties and form groups to maximize their ability to leverage resources and mobilize for collective action (Katz, et

al. (2004). In many LLCs this principle is not a primary factor since the group isn't striving towards a common goal benefitting the group itself.

The fourth of the five network perspectives developed by Katz, et al. (2004) comes from cognitive theories, specifically the theory of transactive memory systems and the theory of cognitive consistency, both of which apply to studying small groups. The theory of transactive memory explains how group members seek out and identify the talents of others in the group in order to leverage these skills and expertise. This theory focuses on what group members think the other members know. The cognitive consistency theory centers on whom group members think other group members like. The LLC helps facilitate this perspective by providing a ready assembled group of students with similar majors, taking similar courses, and living in the same building. This homogeneous group setting reduces the time necessary to determine members who may be able to assist students as they tackle their new course work.

The fifth network perspective explains group communications based on homophily (Katz, et al., 2004), stating that group members are more likely to establish ties with group members like themselves. According to these researchers, groups constructed of similar people are likely to have less conflict and experience higher satisfaction levels. The LLC, populated with students in the same academic major and taking similar classes, helps facilitate this network perspective.

Overall, LLCs facilitate all five social network perspectives identified by the research conducted by Katz, et al. (2004). While social network analysis (SNA) can

effectively connect the nodes of the network, it is not as effective when the network is dynamic (Carley, 2003). Carley reports that SNA typically focuses on "small, bounded networks, with two to three types of links (such as friendships and advice) among one type of node (such as people), at one time, with close to perfect information" (p. 2). In addition, while SNA identifies critical nodes in the network regarding who is important and why, it does not allow for full assessment (Carley & Pfeffer, 2012). Even with these limitations, social network theory provides the foundations for this study. This research will explore network measures to determine which, if any, contribute to academic performance.

Hierarchical Linear Modeling

This study used hierarchical linear modeling (HLM), a specialized form of regression, for data analysis. Regression is a statistical process designed to determine the extent of a relationship, if one exists, between a dependent variable and one or more independent variables.

Huck (2012) identified three types of multiple regression: simultaneous multiple regression, stepwise multiple regression, and hierarchical multiple regression. As the names suggest, simultaneous multiple regression considers all independent variable at the same time, while stepwise multiple regression enters independent variables into a regression based on mathematical criteria determined by computer software. In the forward stepwise model, the software searches for an independent variable that best predicts the outcome variable. The software then adds additional predictor variables to continue determining the regression equation and explaining the outcome variable. On

the other hand, backward stepwise regression begins with all variables in the model, subsequently removing the ones that do not contribute to the outcome variable (Field, 2104). Hierarchical multiple regression adds variables in an order determined by the researcher. In this method, the researcher adds known predictors established from previous research into the model. Once the importance of these predictors are determined, the researcher adds additional variables into the model (Field, 2014).

The issue with these regression techniques is that they do not consider the effects of the grouped data found in educational settings (Nezlek & Zyzniewski, 1998; Woltman, Feldstain, MacKay, & Rocchi, 2012; Lee, 2000). Woltman et al. (2012) and Wech and Heck (2004) identify three types of statistical processes used for analyzing this type of grouped data. The first process, disaggregation, assumes all data resides at the individual or hierarchy level one (i.e., student level), ignoring the presence of higher-level (i.e., school level) grouped differences. The second process, aggregation, groups variables at higher levels, thereby losing lower level differences. The third process, HLM, is a form of ordinary least squares regression designed to take into consideration nested or grouped data often found in educational, health, social, and business data (Woltman at al., 2012; Nezlek & Zyzniewski, 1998). This statistical process accounts for shared variances between or across levels of grouped data (Wech & Heck, 2004; Lee & Bryk, 1989) by running regressions of regressions. The first regression conducted involves within level models followed by between level models (Wech & Heck, 2004; Williams, 1999; Nezlek & Zyzniewski, 1998). HLM's ability to process the contextual effects of variables in a hierarchical environment makes it the most useful tool in an educational setting (Lee,

2000; Williams, 1999). While traditional regression techniques yield biased results caused by the relationships between variables, HLM takes these into consideration (Williams, 1999).

Theoretical Framework

Complexity theory is the theoretical framework guiding this research. As Marion and Gonzales (2014) explain, complexity occurs through dealings within networks, describing how individuals influence others who, in turn, influence others within a network. It also describes how pressure builds in an organization caused by these influences and interactions and how the organization or network changes as a result. Complexity theory provides a framework for understanding the underlying behavior of interdependent individuals in a network (Marion & Gonzales, 2014) as it is the investigation of the dynamic interactions of symbiotic and adaptive individuals affected by internal and external forces (Marion, 2008). Marion suggests there are three dynamics operating on individuals in a network. First, the network does not need external influences to create order within the network; rather interactions within the network create order. Second, as the network evolves or interacts, there is a tendency to become destabilized. This destabilization results in a new and changed organization. Lastly, the future is unknown. Interactions within the network are affected by other interactions within the network that are random and complex, causing even more complex and unpredictable interactions (Marion, 2008).

Summary

The foundation for this study is student development theory. While other researchers have validated the theories presented in this chapter many times, a study of the literature does not reveal any work with respect to the underlying interactions of student involvement from a network perspective. The purpose of this research is to begin to look at student involvement in an LLC from this perspective by examining the network measures from a dynamic network point of view. This study used complexity theory as a theoretical framework, network analysis using ORA software, and statistical analysis using JMP to investigate the complex interactions of individuals within a complex network affected by internal and external forces on an LLC.

Chapter III

RESEARCH DESIGN AND METHODOLOGY

To examine how student networks in a living learning community (LLC) influence student academic achievement, this quantitative study first used ORA, a Dynamic Network Analysis (DNA) software tool, to explore the development of network dynamics in an LLC to determine how it influences academic outcomes/achievements. Next, JMP, a statistical software tool, analyzed the ORA-derived network to determine which network measures contributed to academic success at the university. Specifically, this study explored the following research questions:

- How did network density, component statistics (isolates, dyads or pairs, triads, and larger groupings), and cliques develop and evolve over the course of the semester?
- What study, social, and advice networks, as identified by Newman Groupings, developed over the course of the semester?
- What ORA-derived network measures predicted positive academic performance when compared to a student's predicted GPA?

This chapter describes the setting and sample of the study, presents an overview of the DNA tool, and explains the research design implemented for this study. The research design section details the participants from the LLC, the structured interviews, and the data collection process, while the data analysis section describes the DNA tool (the network statistics considered for examination), and the comparison planned between

the students' projected grade point averages and their actual grade point averages earned at the end of the semester.

Research Design

This research studied the 131 students in a 2015 – 2016 academic year LLC consisting primarily of undergraduate business and behavioral science majors, one of 21 LLCs at a mid-sized, four-year research university in the southeastern United States. According to the university's housing web site such "LLCs provide a holistic approach to student development and learning through academic partnerships, service-learning opportunities, and research initiatives. Each uniquely-designed community facilitates meaningful connections between students, faculty, and staff through programming and other opportunities." The LLC studied here is under the auspices of the business college at the university, which consists of pre-business, graphic communications, and behavioral science (sociology, anthropology, political science, and psychology) students.

The research design for this investigation consisted of three parts: a structured interview, network data collection, and data analysis. The structured interview collected information that served as the response alternatives for the two network surveys administered to LLC residents.

Participants

The LLC participants resided in a common residence hall; while ideally, all students assigned to this residence hall would be students from the same college, for a variety of reasons; this was not the situation with this LLC. When assigning students to the designated LLC residence hall, Housing gives first priority to the organizing college's

students. However, at times students request specific roommates, who may or may not be in their college, requests that Housing usually honors. When the list of students who specifically requested the LLC is exhausted, Housing fills the remaining spaces with other business and behavioral science students or students from any other campus major.

As a result of this housing room assignment policy, of the 131 students assigned to the LLC, 67 students (51.1%) volunteered for the program and 64 students (48.9%) were assigned to the residence hall by the housing office. In the 2015-16 academic year studied, 127 of the 131 students (96.9%) signed an LLC contract meaning they agreed to participate in the programmatic elements of this learning community. The academic majors selected by the LLC students included 105 pre-business and behavioral science majors (80%) and 26 majors (20%) from outside the college. Of the pre-business and behavioral science students, 79 were pre-business majors while 26 were behavioral science majors. Table 3.1 provides the majors and the number of students in each for the LLC studied. The cohort consisted of 76 males and 55 females.

Structured Interview

The researcher conducted structured interviews with thirty-two residents from the previous year's LLC (the 2014-2015 academic year), each being asked the same questions in order to determine the survey response scales (i.e., to determine an appropriate list of responses to the question about the useful knowledge a respondent may possess). Prior to asking the questions in the exploratory survey, the researcher explained the following:

1. The questions asked are part of a research project for a PhD dissertation designed to study the academic achievement in a network comprised of LLC residents.

Table 3.1

Number of Students in each Major in the LLC

Pre-Business and Behavioral Science Students		
Pre-Business	79	
Psychology	7	
Political Science	5	
Anthropology	2	
Economics BA	8	
Graphic Communications	4	
Total Pre-Business and Behavioral Science Students		105
Other Students' Majors		
Art and Architectural History Undeclared	1	
Agribusiness	1	
Agricultural Mechanization	1	
Architecture	1	
Biology	4	
General Engineering	2	
Communications	1	
Computer Science	1	
Construction Science and Management	2	
Early Childhood Education	1	
Elementary Education	1	
English	1	
Food Science	2	
Language and International Trade	1	
Mathematical Sciences	1	
Pre-professional Health Studies	3	
Parks, Recreation, and Tourism Management	2	
Total Students in Other Majors		26

2. These questions are part of an exploratory survey to determine the range of possible answers to survey questions for the research.

3. There are no right or wrong answers. Students are to provide answers based on their own experiences in the LLC and not try to anticipate what they thought the investigator wanted to hear. This explanation was important since the researcher had taught many of the exploratory survey respondents the previous semester in their introductory business class.

The exploratory survey (see Appendix A) consisted of four questions, the first two being resource-related questions asked the students what academic and social resources they used during their first semester at the university. The second two questions, which were knowledge-based, asked the participants what academically based specialized skills they brought with them to the university and what they believed their academic strengths were. Appendices B through E contain the consolidated responses from all 32 students. The network surveys developed for the LLC studied used these consolidated responses from this exploratory survey.

Data Collection

A whole network study survey was administered. According to Mardsen (2011), a whole network study is appropriate when the researcher seeks to determine the structure of a bounded group by collecting data on one or more types of relationships that link the agents in the group. This approach is possible only when the group studied is relatively small or moderate in size. In this case, the population consisted of 131 students in the LLC, making a whole network study possible and desirable.

Marsden (2011) further identified the following three instruments for a whole-network study: the sociometric test, a cognitive social task, and socio-cognitive mapping

and pile sorts. For this research, the sociometric test best suits this study's needs as it allows respondents to identify people with whom they have a predetermined relationship. In the surveys used here, the respondents viewed a list of possible answers when responding to questions. While this practice produces larger networks and is more time-consuming and tedious for respondents, this methodology limits measurement errors due to forgetfulness (Marsden, 2011). The researcher included each student's formal name as well as their "go-by" name, where relevant, to ensure students could correctly identify associations in appropriate survey questions.

The researcher administered the initial survey instrument via Qualtrics shortly after the first-year students arrived for the fall semester. During a mandatory residence hall meeting, the researcher introduced the research and obtained signed consent forms from all LLC residents. Following the meeting, participants received a link to the Qualtrics survey via e-mail. Periodically, participants received reminders to complete the survey instrument until all had responded. This initial eight-question survey established a baseline pre-test for the LLC network.

After answering basic demographic questions (name and gender), participants identified LLC students whom they previously socialized with or knew, establishing an agent-by-agent matrix for analysis. The survey also determined their initial beliefs regarding the benefits of participating in an LLC. Specifically, the instrument asked if they believed participating in the LLC would have a positive impact on their first semester at the university, if they believed participating in the LLC would make their transition to the university easier, and if they believed they intended to remain at the

university to complete their undergraduate degree. Finally, the instrument asked two knowledge-based questions: Specifically what specialized skills they brought to the university that would help them succeed and what their academic strengths were. The response scales provided for these last two questions came from the previously described structured interview. Appendix F includes the initial survey questions and the Qualtrics measures used for this survey instrument.

At the beginning of the spring semester, the LLC students completed a follow-up survey using Qualtrics, again using their laptops at a mandatory residence hall meeting. Students received the Qualtrics survey link just prior to this meeting. After this meeting, students periodically received reminders to complete the survey instrument until all participants responded.

In this survey, participants identified students with whom they socialized and with whom they studied from a list of LLC participants, establishing two agent-by-agent matrixes for analysis. As in the initial survey, participants answered questions indicating if the LLC was having a positive impact on their first semester at the university and making their transition to the university easier, and whether they intended to remain at the university to obtain their undergraduate degree. Students then identified the academic resources and social events and resources they used during their first semester. Additional LLC-centric questions asked if they were satisfied with the general, academic, and social support provided by this community. Finally, students answered questions to determine if participating in the LLC enabled them to accomplish its four programmatic elements (i.e., helping students achieve their academic goals, helping students achieve

their personal and professional goals, helping students increase their leadership skills, and helping students increase their community involvement). Appendix G includes the items and measures used in Qualtrics for this follow-up survey instrument.

Variables

Network Statistics. This section identifies and explains a few of the many network measures important to this research. ORA software, which was used here to produce the network statistics, produces a number of measures that evaluate the degree to which and manner in which each participant is engaged in the network's information flow. One statistic of interest in this study is betweenness centrality. As defined in Carley, et al. (2013), betweenness measures the degree to which an individual mediates information flow between other individuals in a network, and betweenness centrality indicates the degree to which an individual is a broker of indirect connections in a network (Knoke & Yang, 2008). An agent is central to the network if it lies between other agents in the network (Wasserman & Faust, 1994). Potentially influential agents are positioned to pass information between agents and serve as a gatekeeper between groups (Carley, et al., 2013). Agents with high betweenness centrality, then, are in the position of passing and controlling information flow between groups or among individuals in the network (Hanneman & Riddle, 2011).

Another useful network measure is the clustering coefficient, which measures the degree of clustering in a network (Carley, et al., 2013). Clustering is the "tendency of friends of friends to be friends" (Freeman, 2011), with the clustering coefficient identifying the degree of local grouping in a network and the consequent localization of

information (Carley, et al., 2013). A high coefficient indicates that the given agent is linked to numerous clusters in a network.

The eigenvector centrality measure, particularly relevant to this study, identifies how central an individual is to others in the network (Robins, 2015), with Borgatti, Everett, and Johnson (2013) identifying it as a measure of popularity. Specifically, individuals with high eigenvector centrality measures connect to individuals who are also well connected, and individuals are central to a network to the extent that the individuals they connect to are central to the network (Borgatti, et al., 2013; Carley, et al., 2013). According to Carley, et al., (2013), a well-connected person linked to well-connected people (an individual with a high eigenvector value) can spread information much more quickly than one who links to less-connected people in a network.

Other network statistics are discussed and defined relative to this network study as their relevance becomes apparent in Chapter Four (see Table 4.3).

Selection Index (SELI). One of this study's e research questions attempted to determine if participating in an LLC positively affects a student's academic performance. For this study, the researcher used the student's selection index (SELI) described below, comparing it to the student's actual grade point average (GPA).

The research university where this study was conducted uses a high school student's SELI to help determine the students it admits to the university each year. The researcher interviewed the university's admissions personnel who provided SELI background information, explaining how this index was used to determine the school's list of accepted students each year. The SELI tool is a regression analysis of the past

three years of enrolled students' data to predict applicants' GPAs at the end of their first year.

The university has used this tool to help determine admission acceptances for more than four decades, finding that this predictive model has proven to be accurate each year to within approximately .02 of the cumulative freshman class average GPA. Due to the accuracy of this model, the SELI is the primary admissions decision factor at this university. While other secondary factors can be used in the decision-making process, this university does not require any of the other common inputs used by many other universities (i.e.: essays, interviews, etc.) to determine the accepted students list.

The specific factors used in computing the SELI include the student's high school class ranking (in percentage) or estimated class rank if not computed by the high school, standardized test scores (SAT reading and math scores or ACT composite and components), and high school GPA. The regression analysis categorizes a student's class rank/GPA as the primary factors for determining academic success. The factors are not weighted; instead, they are computed using a regression analysis based on class ranking and test scores versus the student's cumulative GPA. This computation uses data from the past three years of enrolled students to determine the slope of the regression line.

Since high schools vary in academic rigor and/or may not have a representative normal population distribution of students, a student's high school rank/GPA may not accurately reflect their ability and their resultant SELI calculation. Students at a high schools with more competitive academic rigor and a more resourced student population may receive a lower class standing percentage and GPA than if they had attended a

school in which the academic rigor was not as competitive and one with a smaller resourced student population.

An "Experience Factor" compensates or adjusts for these differences. If at least ten students from an individual high school attended the university in the last three years, the administrators compare this group's SELI and actual GPA with that specific population. If the group's actual GPA exceeds or falls below the computed SELI, the applicant's SELI score from that high school receives an experience factor kicker. For example, if the group's average SELI is 2.81 and their actual GPA is 2.92, then applicants from that high school receive a .10 kicker to their score. Positive and negative experience factors occur in .10 increments, and SELI scores may increase by as much as the comparison allows. However, the most a high school's applicant pool can be decremented is .30 GPA points to ensure high achieving individual students are not negatively affected in the process.

Dependent Variables. The dependent variable in this study is GPA difference. The researcher computed this variable by subtracting the student's admissions computed SELI from their actual earned GPA. A positive GPA difference indicates the student outperformed expectations.

Model

Figure 3.1 provides a pictorial representation of this research. A student's GPA difference is the central, dependent variable for this research, computed by subtracting the students' admissions computed SELIs from their actual earned GPAs. Ideally, all GPA difference values would be positive, meaning that all students outperformed their

expected GPA. The independent variables that may affect the students' ability to exceed their SELIs include the LLC's social, advice, and study networks, the students' beliefs regarding the ability of the LLC program to assist them in succeeding at the university, the students' genders, and their desired academic majors. This research seeks to evaluate these independent variables relative to their ability to positively influence students' academic achievements as measured by their earned GPAs.

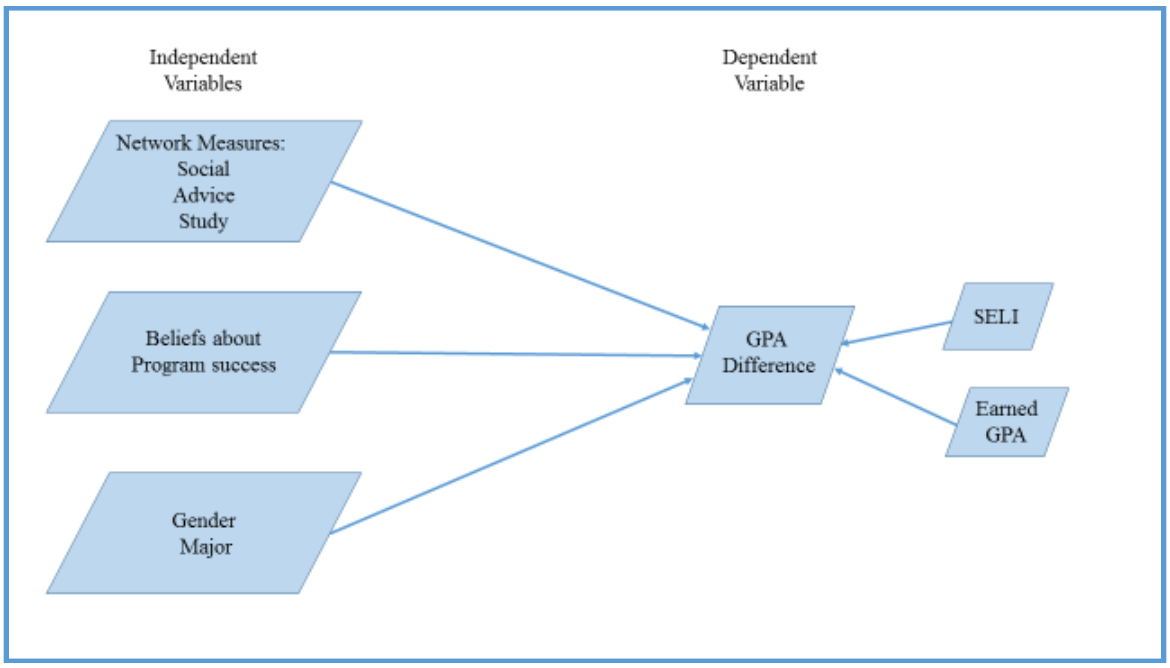

Figure 3.1.

Research Model

Data Analysis

Dynamic Network Analysis

This research used Dynamic Network Analysis (DNA) methodology to investigate the data. DNA studies complex socio-cultural systems, specifically the who, what, where, how, and why elements of a network, through meta-network representation,

extending the social network analysis to a geo-spatial level (Carley & Pfeffer, 2012). DNA, which is applicable for large-scale networks, incorporates traditional social network analysis with link analysis and multi-agent systems (Carley, 2003).

Carley (2003) identifies three key features of DNA for analyzing changing networks. The first feature, the meta-matrix, is a color representation of the entities, specifically the people, knowledge/resources, events/tasks, and organizations, and the connections among them. The result is a set of inter-linked networks where changes over time in one network cause changes in other networks. The second feature of DNA is that the ties in the meta-matrix are probabilistic, with the software determining the probability of a tie between network nodes and how these probabilities can potentially change over time. The third feature is the use of multi-agent technology, important because agents or nodes in a network learn and alter the networks. The multi-agent technology features of DNA extend the traditional social network analysis to allow for the examination of the ever-changing networks typically found in LLCs. The research uses this tool to study LLC network activity, exploring it and network engagements with respect to academic achievements.

ORA, the network analysis software used here to conduct the DNA methodology, was developed Dr. Kathleen M. Carley of the Carnegie Mellon University School of Computer Science. A statistical analysis package for analyzing complex systems like dynamic social networks, it detects risks or vulnerabilities in an organization's personnel, knowledge, resources, and tasks entities (Carley, Pfeffer, Reminga, Storrick, & Columbus, 2013). ORA then uses these entities and the relationships between them in

meta-matrixes to manipulate the data. This software is capable of analyzing a large variety of networks including social networks, activity networks, knowledge networks, communication networks and more, meaning ORA can analyze large-scale, multi-mode, complex, dynamic social networks (Krempel, 2011) as it has the ability to present data on more than 150 measures (Carley & Pfeffer, 2012).

The input to ORA is the meta-network, or meta-matrix, a data structure define by Krempel (2011) as an ecosystem of interlinked networks representing complex systems like organizations. Each meta-network or group of networks consists of nodes (a representation of real-world item – the who, what, where, how, and why), links (a representation of a tie, edge, connection, or relation link between any two nodes), networks (a representation of a set of nodes of one type and the links between them), and attributes. In this research, the meta-network will represent the LLC and the meta-network will be comprised of the agents, here the students; knowledge; resources; and beliefs.

The ORA Visualizer presents conceptual images of the network studied. Using its graphical capabilities, ORA presents geospatial networks and node clouds (Carley et al., 2013). This ORA function analyzed the relationships and interactions between the students (agents) participating in this study.

Data Reduction

The program belief variables in this study serve as one of the independent variables. They were addressed in three survey questions using seven-point Likert scales for the responses. Data reduction procedures were then used to reduce the belief-related

Likert-scale survey responses to groups or clusters of variables (Field, 2013). Researchers use this technique for three purposes: to understand the variable set structure, to calculate variables that measure underlying constructs, and to reduce the data set to a more manageable size (Field, 2013). For this research, the researcher used factor analysis to reduce the belief data to a more useable set of measures. As a result, further analysis is possible using the factor scores, or weighted scores for each cluster instead of the original raw data (Field, 2013), thus significantly increasing the accuracy of the data measures. The factor analysis data replaced the belief data in the data file before JMP processed it for analysis.

Regression Analysis

Next, regression analysis was conducted to create a model that determined conditions contributing to academic success in the living learning community. Regression predicts or explains the relationship between variables (Field, 2013; Huck, 2012; Ott & Longnecker, 2001). In this research, the outcome or dependent variable was the student's academic outcome while the predictor variables included the network statistics or measures. Field (2013) identifies three regression models, the first being hierarchical where selected predictors, based on past work, flow into the model in order of importance in predicting outcomes using the researcher's past experience. The second regression model is forced entry where predictors are selected based on theoretical reasons and entered into the model simultaneously with no assessment regarding the order in which they are entered. The last regression model is stepwise where mathematical criteria determine the order the predictors are entered into the model (Huck,

2012). Fields (2013) cautions researchers against using the stepwise model since the variable entry order is determined mathematically and the fit of variables based on other variables in the model instead of prior research or researcher experience. Since there appears to be little research concerning academic outcomes in a living learning community, there is no basis for determining the predictors or variables to enter and their order of entry into the model (as in hierarchical or forced entry regression). Even though Fields (2013) discourages it, he does indicate that stepwise regressions are useful in exploratory model building, as is the case in this study.

Due to the large number of variables in the ORA All Measures report, the researcher used several regression approaches here. This exploratory study's first regression analysis was stepwise to remove measures that did not have an impact on the outcome. This stepwise regression used a mixed direction P-value threshold-stopping rule with P-values of 0.25 probability to enter the variable or predictor and 0.25 probability to leave the variable in the model.

Following the stepwise regression, a standard least squares or ordinary least squares was conducted. This regression model estimates measures with the goal of minimizing the sum of the squared residuals between observations (Field, 2013; Sall, Lehman, Stephens, & Creighton, 2014). The researcher examined several measures of regression assumptions. The variance inflation factors (VIF) measures the amount of variance shared by pairs of variables (Ott & Longnecker, 2001), or their multicollinearity. A VIF greater than ten indicates high collinearity exists between certain variables or measures in the model (Field, 2013; Ott & Longnecker, 2001). Starting with the measure

with the highest VIF, the researcher sequentially and individually removed each measure until the VIFs for all remaining measures were less than ten. Next, the researcher ran a Durbin Watson test to determine if correlation between cases exists. With a possible range of zero to four, a Durbin Watson value of two indicates that the residuals among cases are uncorrelated (Field, 2013), a coefficient between two and four, a negative correlation between cases, and coefficients between zero and two, positive correlations among cases. Finally, the researcher also performed a hierarchical linear analysis to determine the existence, if any, of second level effects involving gender or academic major.

JMP version 12 software, a software package designed to allow the user to investigate data fit models and patterns (Sall et al., 2014), was used to conduct these regression analyses.

Role of the Researcher

The researcher and the LLC's administrator are colleagues who work in the same office. The result from this study are of specific interest to the researcher since the college spends some of its limited resources for this community to exist and operate. While research tells us the LLC, as currently structured, addresses the very factors scholars identify as key for student success and retention, there is no hard data demonstrating that aspects of a learning-living community network actually contribute to student success. While the researcher is interested in supporting the LLC idea, it is imperative to maintain impartiality and interpret the data accurately and objectively.

Ethical Considerations

Each respondent received a document of informed consent providing the opportunity to opt out of the study. The researcher maintained the confidentiality of the participants throughout the study, beginning by replacing actual student names when data were entered into the ORA software.

Summary

This research focused on determining what measures of an LLC network contribute to the academic achievement of its members, using the ORA software tool to study this dynamic network. Conducting a structured interview with an earlier LLC provided the survey scale responses for initial survey questions, completed shortly after arrival by the new freshman LLC students, who subsequently completed the follow-up survey at the beginning of their second semester. This pre- and post-survey technique allowed the researcher to observe the network as it developed over the course of the semester. The ORA visualizer and the JMP statistical software tools provided the analysis for observing this development and for determining what network measures contributed to the students' academic success as measured by their GPAs.

CHAPTER IV

FINDINGS

The purpose of this study was to determine what, if any, networks or network measures contribute to increased academic achievement in a living learning community (LLC). Business and behavioral science LLC students were interviewed as the initial step in this study using a structured interview. The results of these structured interviews are detailed in Appendices B through E. The data collected in these interviews were then used to construct two surveys for the subsequent network analyses of first-semester freshman business and behavioral science LLC students. This first of these surveys was administered five days after the beginning of the students' first (fall) semester while the second was administered five days after the second (spring) semester began. Both surveys were collected using Qualtrics, a survey data collection software program, and their results were entered into ORA software to analyze the LLC's network measures. Once basic network characteristics were identified, these measures were exported into JMP, a statistical analysis software program, for further analysis.

Specifically, this study explored these research questions:

- How did network density, component statistics (isolates, dyads or pairs, triads, and larger groupings), and cliques develop and evolve over the course of the semester?
- What study, social, and advice networks, as identified by Newman groupings, developed over the course of the semester?

- What ORA-derived network measures predicted positive academic performance when compared to a student's predicted GPA?

To address these questions, this chapter will present the Newman groupings, used to identify unusually dense clusters in large networks (Carley, et al., 2013), for the LLC's social, advice, and study networks. Analysis of the social network Newman groupings will compare network connectivity at the beginning of the students' first semester to network connectivity at the beginning of their second semester. Next, this chapter will analyze the advice and study networks. Finally, this chapter will present a statistical analysis of the ORA network measures or variables using JMP software.

Cohort

The 131 students in the 2015-2016 academic year LLC included 67 (51.1%) who volunteered for the community and 64 who were assigned to the LLC residence hall and, thus, had the opportunity to participate in the program. One hundred twenty-seven of the 131 (96.9%) signed a contract stating that they agreed to participate in the LLC's programmatic elements. The academic majors of the students in the community included 105 pre-business and behavioral science majors (80%) and 26 majors (20%) from outside the college. Of the pre-business and behavioral science students, 79 were pre-business majors while 26 were behavioral science majors. The cohort consisted of 76 males and 55 females. All 131 LLC participants completed both survey instruments.

Social Network Descriptive Statistics

One of the questions on the initial survey administered at the beginning of the fall semester asked participants whom they knew at the time they matriculated into the

university. This question aimed at determining the LLC's social network as the students began their college experience. The visualization of this network created by ORA software seen in Figure 4.1 represents the centrality of the nodes with respect to the other nodes in the network, while the lengths of the links represent the strengths of the connections between nodes. Nodes located on the periphery of the network are weakly connected (if at all) compared to the nodes at the center of the network. As expected, the figure shows a relatively disconnected network of 131 newly arrived students.

In addition to network visualizations, ORA provides statistics that are descriptive of the network as a whole. Network *density*, for example, is the sum of the links divided by the number of total possible links (Carley, Pfeffer, Reminga, Storrick, & Columbus, 2013; Borgatti, Everett, & Johnson, 2013). A very dense network has difficulty processing decisions because of the many conflicting needs that must be balanced, while a network with low density can have so few conflicting needs that there is insufficient pressure within it to drive change (Kauffman, 1993; Marion, 2016). The LLC's density at the beginning of the fall semester was a very low 0.007 (on a 0 to 1 standardized scale), a result that was expected as the survey was administered shortly after these new undergraduate students arrived on campus. Density, however, was not zero because

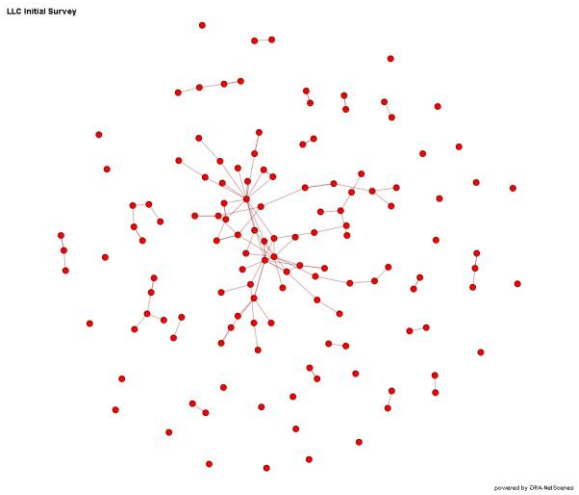

Figure 4.1.
Visualization of students who knew other students prior to beginning their first semester.

some students requested and were assigned specific roommates based on their housing applications.

In addition to density, ORA describes networks based on their connectivity. This visualization of a network is referred to as a graph. According to Wasserman and Faust (1994), an important graph property is whether the graph is connected or disconnected. In a connected graph, a path exists between every node in the network meaning all pairs of nodes are reachable (Wasserman & Faust, 1994). The opposite is the case in a disconnected graph: all network nodes are not connected even though two or more subsets of connected nodes may exist. Robins (2015), Wasserman and Faust (1994), Scott (2103), and Carolan (2014) define the subsets or subgraphs of connected nodes in a disconnected graph as *components* that divide the network into separate regions with no ties between them. A graph with only one component is considered connected while a graph with more than one component is considered disconnected. Scott (2013) views the network component pattern, the number of components as well as their size, an indication of the ability to transfer or communicate information within the network, meaning identifying these two characteristics results in a basic description of a network's structure. It is expected that over time a network would move from a disconnected to a connected network as nodes became associated with other previously unconnected nodes.

ORA identifies network components as isolates (single unconnected nodes), dyads (pairs of nodes), triads (three connected nodes), and node structures of four or more connected nodes. The ORA analysis conducted in this study revealed the initial social network component statistics consisted of 27 isolates (unconnected individuals), 13

dyads, 2 triads, and 3 network structures with 4 or more connected individuals. Table 4.1 lists these network descriptive statistics in the initial survey column.

Table 4.1

Network descriptive statistics for the initial and follow-up surveys.

	Initial Survey	**Follow-up Survey -- Agent-by-Agent**		
Statistic	Social	Social	Advice	Study
Density	.007	0.123	0.018	0.027
Isolates	27	0	13	9
Dyads	13	0	1	2
Triads	2	0	0	0
Larger	3	1	1	1
Cliques	8	952	48	108

The final descriptive statistic for the initial network is the *clique*, which is a sub-set of adjacent nodes where all possible ties between the nodes in the sub-set of nodes are present (Robins, 2015; Wasserman and Faust, 1994; Scott, 2013). In a clique, agents talk more among themselves than they talk with agents outside the clique. ORA identified eight cliques in the initial network based on the initial survey.

To allow reflection on social network changes occurring during the semester, students completed a variation of the "whom do you know or socialize with" question in a second survey. The ORA visualization of this network is seen in Figure 4.2. A visual comparison of this figure with the initial social network visualization seen in Figure 4.1

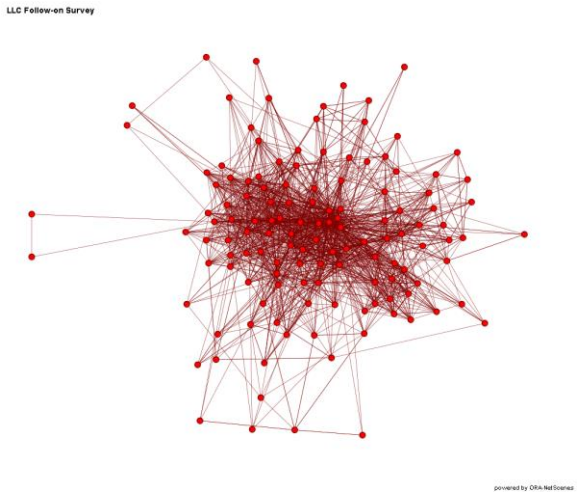

Figure 4.2.
Visualization of students who socialized with other students in the LLC by the end of the first semester.

indicates a more connected network. This observation is confirmed when evaluating the network's descriptive statistics and components. As shown in Table 4.1 density increased from .007 at the beginning of the semester to .123 at the end of the semester. With respect to the network component statistics, the social network evolved from a disconnected to a connected network as isolate, dyad, and triad nodes became connected into one large network. The first network, then, showed considerable dispersion, which decreased significantly by the beginning of the second semester. Comparing the initial social network to the social network at the end of the semester, cliques increased from 8 to 952. As these results suggest, students quickly forged social networks and relationships during their first semester

Advice Network Descriptive Statistics

In the follow-up survey administered at the beginning of the second semester, the students identified whom they sought for advice within the LLC during their first semester. This agent-by-agent survey question determined additional interactions within the LLC beyond social interactions, establishing the advice network seen in the ORA-produced visualization shown in Figure 4.3. The network descriptive statistics including density, component counts (isolates, dyads, triads, and larger clusters) are displayed in

Table 4.1. The density of the advice network was .018, and the component count included 13 isolates, 1 dyad, and 0 triads, with the remaining students being connected in the larger network. There were 48 cliques in the advice network.

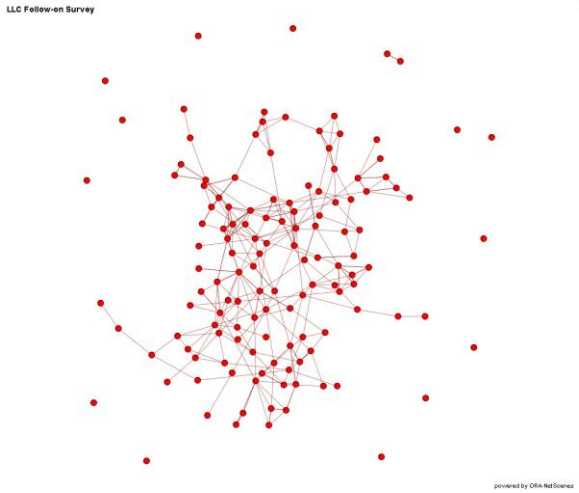

Figure 4.3.
Visualization of students who sought other students in the LLC for advice during the first semester.

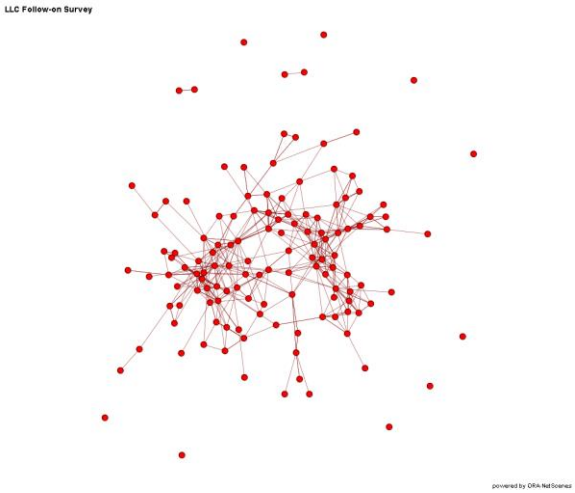

Figure 4.4.
Visualization of students who studied with other students in the LLC during the first semester.

Study Network Descriptive Statistics

The third agent-by-agent question used to determine network interactions asked students with whom they studied, the responses establishing the study network. Figure 4.4 provides the ORA-produced visualization of this network. The network descriptive statistics included the density, component counts (isolates, dyads, triads, and larger clusters) presented in Table 4.1. The density of this disconnected network is .027 and consisted of 9 isolates, 2 dyads, and 0 triads, with the remaining nodes connected throughout the network. There were 108 cliques in the study network.

Newman Groupings

Another way to understand networks is by determining the Newman's groupings within the each network. These groupings find clusters of nodes that are unusually dense or that communicate among themselves more than with agents outside the group (Carley, Pfeffer, Reminga, Storrick, and Columbus, 2013). To determine these groupings, Girvan and Newman charted paths between nodes that lay along the shortest path between linked nodes, their algorithm uncovering groups within the network (Freeman, 2011). For this study, the researcher used the student's selection index (SELI), gender, and academic major attributes to determine Newman groupings within the LLC's social, advice, and study networks.

Social Network Newman Grouping

This section examines Newman's groupings to identify unusually dense clusters of nodes (or clusters of nodes that communicate among themselves more than with others), color coding specific attributes to determine if students exhibiting them tend to cluster together. We first color-coded (or overlaid) the student's selection index (SELI), the student's university predicted grade point average based on a regression analysis using high school class

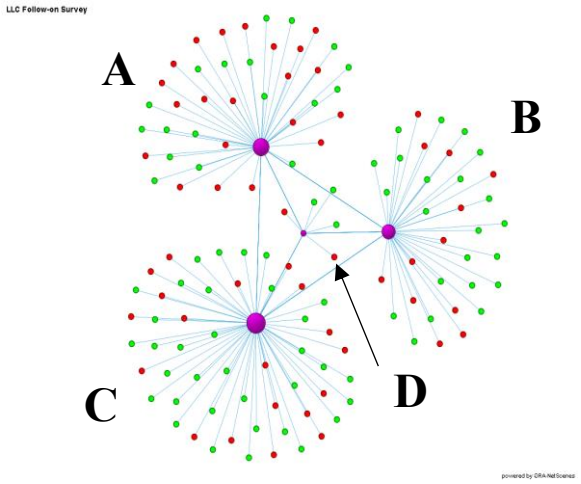

Figure 4.5.
Newman grouping visualization of student's social network color-coded for students who outperformed or equaled their predicted SELI (green) vs students who underperformed their predicted SELI (red).

ranking, standardized test scores (SAT or ACT), and high school grade point average. Figure 4.5 depicts the four Newman groupings for the social network at the end of the first semester, color-coded based on the difference between the student's SELI and actual grade point average: a green node indicates the student outperformed or equaled their computed SELI while a red node indicates the student underperformed his/her SELI. Group A consists of 39 students, with 18 students who exceeded or met their SELIs while 21 did not; Group B contains 34 students, with 22 who exceeded or met their SELIs and 12 who did not, and Group C consists of 53 students, 34 of whom overachieved or met their SELIs and 19 who did not. The smallest group, labeled D, consisted of five students, with three students meeting or exceeding their computed SELIs and two who did not meet their computed expectations. Table 4.2 lists these groupings as well as the social network Newman groups for the gender and academic major attributes.

Table 4.2

Composition of student social network Newman groupings.

Grouping	Positive SELI	Negative SELI	Male	Female	Pre-Business	Behav Science	Other Majors	Total Nodes
A	18	21	37	2	27	4	8	39
B	22	12	34	0	24	5	5	34
C	34	19	4	49	27	11	15	53
D	3	2	1	4	1	2	2	5

Another social network visualization, Figure 4.6, examines Newman groupings overlaid by gender. In this figure, green nodes indicate male students while red nodes

indicate female students. Interestingly, the groups were not heterogeneous: Group A consisted of 37 males and 2 males; Group B, 34 males and no females; Group C, 4 males and 49 females; and Group D, 1 male and 4 females.

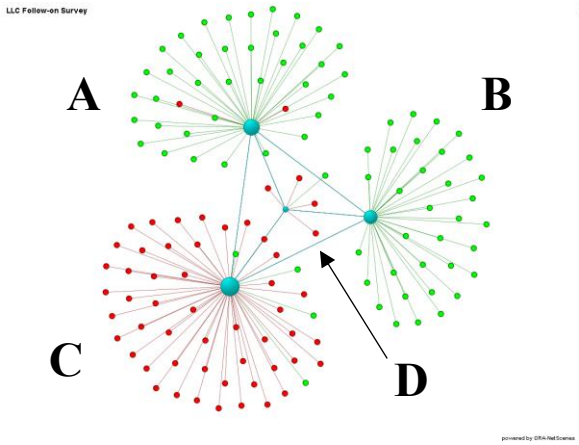

Figure 4.6.
Newman grouping visualizing the student's social network color-coded by gender (males are the green nodes and females are the red nodes).

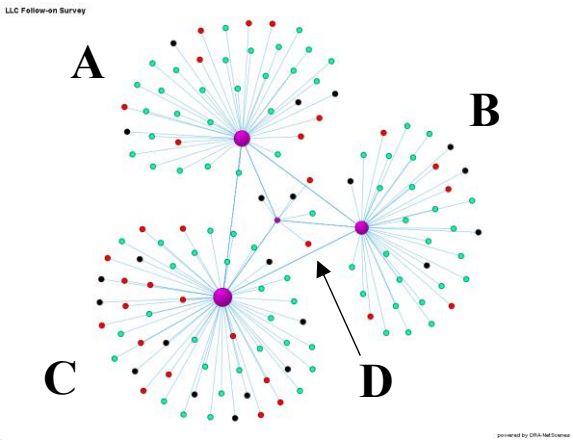

Figure 4.7.
Newman grouping visualizing the student's social network by major (green nodes are pre-business students, black nodes are behavioral science students, and red nodes depict all other majors).

A third social network visualization depicted in Figure 4.7 overlays Newman groupings with academic major. As the founding purpose of this LLC was to provide an academic and social environment for business and behavioral science students, for the purpose of this study, there are three student majors: pre-business (green nodes), behavioral science (black nodes), and all other academic majors (red nodes). When the Newman's grouping visualization was created and overlaid with student majors, Group A consisted of 27 pre-business, 4 behavioral science, and 8 other majors; Group B, of 24 pre-business, 5 behavioral science, and 5 other majors; and Group C, the largest grouping, of 27 pre-business, 11 behavioral science, and 15 students from other majors.

The smallest group, Group D, consisted of one pre-business, two behavioral science, and two students from other academic programs.

Advice Network Newman Grouping

In addition, the LLC can be analyzed by performing the same attribute color-coding analysis (SELI, gender, and academic major) using the student's advice network. Figure 4.8 depicts twelve Newman groupings for the advice network overlaid with students' SELI attributes. Of the 12 groups, eight (B, C, E, F, I, J, K, and L) consisted of more students who outperformed or equaled their SELIs than students who underperformed their SELIs. Three groups (A, D and G) contained more students who underachieved their SELIs than equaled or overachieved their SELIs, and Group H contained the same number of students in each category.

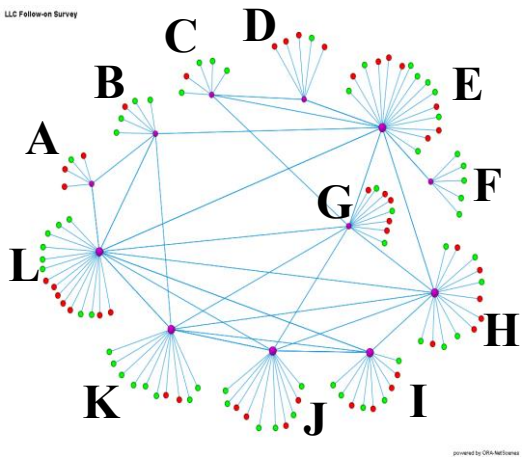

Figure 4.8.
Student's advice network Newman grouping visualization color-coded for students who outperformed or equaled their predicted SELIs (green) vs students who underperformed their predicted SELIs (red).

Figure 4.9 depicts the advice clusters color-coded by gender. As with the social network visualized by Newman grouping and gender, there is little mixing of genders in the groups. Of the twelve Newman groupings, seven were homogeneous in that five groupings (C, D, F, G, and J) contained only male students and two groupings (A and B) contained only female students. The remaining groups contained many more males than

females (group E and I) or females than males (group I, K, and L), meaning none of these groups came close to having equal numbers of males and females. When contrasting the SELI and gender groupings in the advice network, it is interesting to note that the only

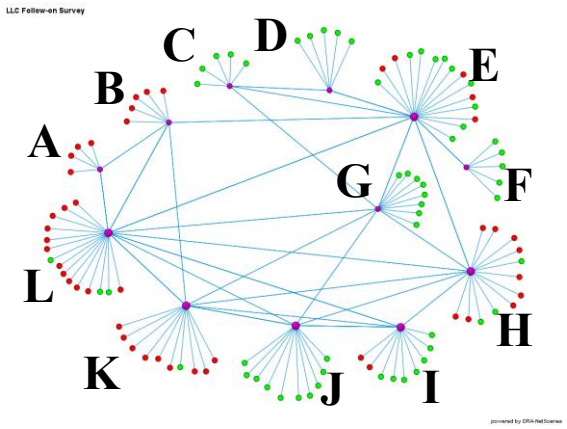

Figure 4.9.
Newman grouping visualization of student's advice network color-coded by gender (green nodes depict males and red nodes depict females).

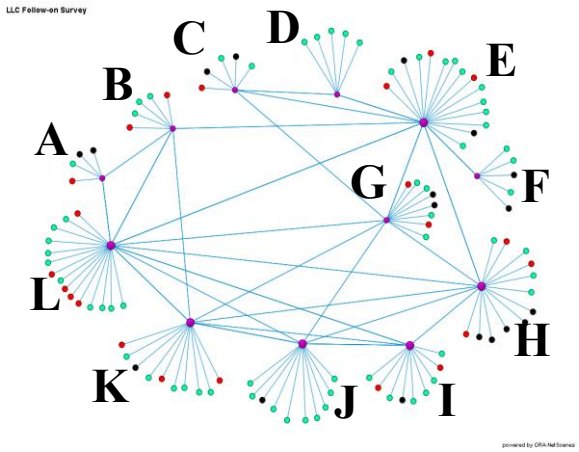

Figure 4.10.
Newman grouping visualization of student's advice network color-coded by major (green nodes are pre-business, black are behavioral science, and red are all other majors).

group whose membership achieved all positive SELI scores (meaning they all exceeded or overachieved their expected grade point average) was Group D, consisting of all males.

Figure 4.10 displays the student advice clusters coded by academic major. Group D is the only one consisting of students in the same academic major – pre-business. Of the remaining groups, four groups (B, F, J, and L) contained a mix of two types of academic majors while seven groups (A, C, E, G, H, I, and K) contained a mix of three academic majors. Group D is the only student collection that is the same gender (male), in the same academic major (pre-business), and exceeded the computed SELI scores.

Study Network Newman Grouping

As in the previous network analyses, the study network also examined the Newman grouping coded for each attribute (SELI, gender, and academic major). Figure 4.11 depicts the six Newman groupings of the study network by the student SELI attribute. Of the six groupings, five groups (A, B, D, E, and F) were almost equally divided between students who overachieved their predicted SELI scores (a positive SELI) and students whose GPAs were below their predicted SELIs (a negative SELI). Specifically, Group A consisted of 7 students who exceeded their SELIs while 6 did not, whereas Group B consisted of 1 student who exceeded his/her SELI while 2 did not. Group D consisted of 5 students who exceeded their SELIs while 6 did not, Group E consisted of 17 students who exceeded their SELIs while 18 did not, and in Group F 2 students exceeded their SELIs while 1 did not. Twenty-five students from Group C overachieved their SELI scores while 11 students did not.

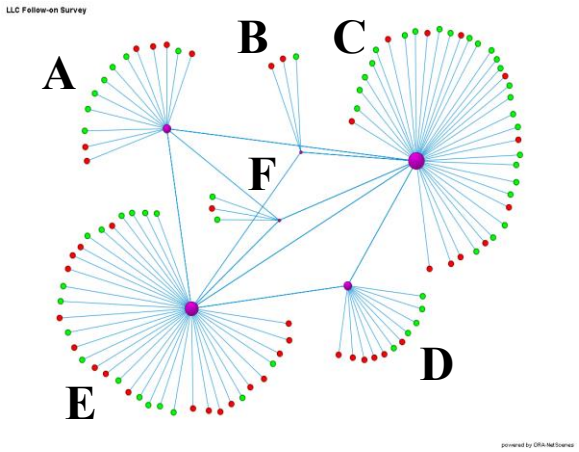

Figure 4.11.
Student's study network Newman grouping visualization color-coded for students who outperformed or equaled their predicted SELI (green) vs students who underperformed their predicted SELI (red).

The overlay of gender on the students' study networks is shown in Figure 4.12, again indicating a wide difference in the distribution of males and females in all but one group. Specifically, groups C, D, and E consisted of more males than females, and groups A and B had more females than males. Group F, with only three students, is the

one exception. Only two groups were populated by one gender – Group D contained only males while Group B contained only females.

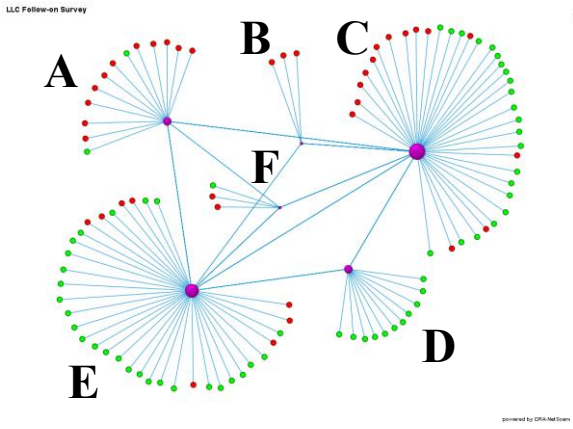

Figure 4.12.
Newman grouping visualization of student's study network color-coded by gender (green nodes depict males and red nodes depict females).

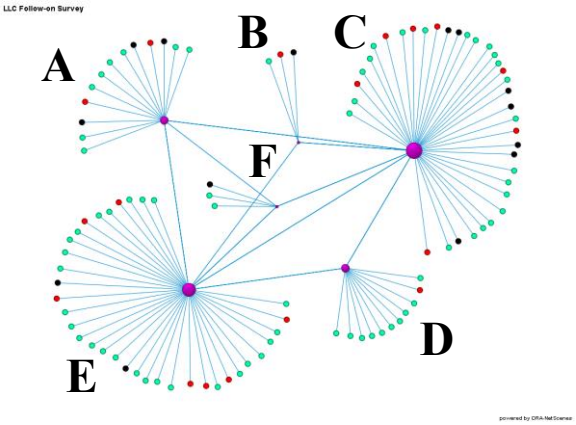

Figure 4.13.
Newman grouping visualization of student's study network color-coded by major (green nodes are pre-business, black are behavioral science, and red are all other majors).

The last attribute visualized in Figure 4.13 represents the study network overlaid with academic major. Due to the large number of pre-business majors in the LLC, five of the six Newman groups (A, C, D, E, and F) contained more pre-business majors than behavioral science and other majors. The one group that did not have more pre-business students than the other majors was a small group with only three students, Group B, which consisted of one student from each academic cluster. Additionally, four Newman groups consisted of a student from each of the three academic clusters (Groups A, B, C, and E) while two clusters consisted of students from two academic clusters (Groups D and F).

Statistical Analysis

The network analysis produced 70 agent-level measures, which were then subjected to statistical analysis and model development using JMP software. These measures are shown in Appendix H. See Table 4.3 for a list of definitions for several of the agent measures used in this analysis.

Table 4.3

Definitions of various network measures.

Agent level Measure	Definition
Clique Count	A clique is a set of at least three nodes where each node is directly connected to every other node. A clique count is the number cliques in a network.
Closeness Centrality	Measures the closeness of a node to other nodes in a network by the shortest path. Explains how fast information spreads through a network or how quickly information can be obtained or shared in the network. Low scores in this measure indicate the node is more central to the network and is likely to receive information more quickly than nodes with a larger closeness centrality.
Cognitive Demand	Explains the amount of effort each agent expends to do its work and communicate. Agents with high cognitive demand are developing into network leaders.
Cognitive Distinctiveness	Measures how much pairs of agents have complementary or opposite knowledge.
Cognitive Similarity	Measures how much pairs of agents have overlapping knowledge.
Ego Betweenness Centrality	The ego network is determined by selecting a node and identifying the agents connected to it. Betweenness centrality measures the amount of information flow through a node or agent in a network. Agents with high betweenness centrality scores are in powerful positions since people depend on them for connections. They are brokers of information between pairs of agents.

In Inverse Closeness Centrality	Closeness centrality measures how quickly agents have access to or can distribute information through, to and from a network. Inverse closeness centrality is the average closeness of a node to other network nodes looking from an agent out to other agents. In inverse closeness centrality examines the number of ties received.
Information Centrality	Measures shortest and indirect paths among agents in the network. An agent with a high information centrality value can receive information faster than others.
Katz Centrality	Measures the relative influence of an agent in a social network. Computed using the total number of walks between a pair of agents including straight lines, circuitous routes, and revisits.
Shared Situation Awareness	Describes the number of shared assets between agents in the network (connections, knowledge, resources, and tasks). Those with high shared situational awareness have an understanding of what others are doing in the network.
Structural Holes Constraint	A structural hole is a missing tie between two agents in a network. A constraint measures the extent to which an agent connects to others who are connected to one another. If Agent A is connected to Agents B and C, and Agents B and C are connected, then Agent A is constrained since B and C are connected.
Total Degree Centrality	Measures the total numbers of ties or connectedness to and from an agent in a network. Individuals with high total degree centrality have more connections in the network and are therefore "in the know."

Sources for these definitions are Carley, et.al. (2013); Wasserman and Faust (1994); Borgatti, Everett, and Johnson (2013); Borgatti (2005); Hanneman and Riddle (2011); Carolan (2014), and Katz (1953).

The agent measures were entered into a fit model analysis using GPA difference, computed by subtracting the students' SELIs (projected GPAs) from their actual earned GPAs, as the dependent variable. The 70 agent measures were used to construct the

model effects. A stepwise regression was first conducted on the 70 agent-level measures to identify those most likely to affect GPA difference, this data run finding six variables of interest. Using these six variables as independent variables, a standard least squares regression was conducted using GPA difference as the dependent variable. The results from this regression are shown in Table 4.4. From these data, variable VIF's, a multicollinearity check, were calculated to determine if there were any abnormal correlations among these six predictors. The variable Total Degree Centrality – Social, having an unacceptable VIF coefficient, was thus removed from the model. Possible autocorrelation was explored using the Durbin Watson statistics. A coefficient of 2.0 is desired for the Durbin Watson as this value indicates the residuals are not correlated to each other. The analysis revealed a coefficient of 1.98, which is within the acceptable range. The plots for heteroscedacity revealed no problems.

Table 4.4.

Results from the Initial Standard Least Squares Regression

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	VIF
Intercept	-0.100722	0.149929	-0.67	0.5030	.
CognitiveSimilarity-2	1.6514479	0.47236	3.50	0.0007*	1.0444109
lnInverseClosenessCentrality-Study	-1.469766	0.782737	-1.88	0.0628	2.9035862
KatzCentrality-Study	1.6035978	0.544935	2.94	0.0039*	2.9782138
TotalDegreeCentrality-Social	-2.861963	1.448378	-1.98	0.0504	11.973322
TriadCount-Social	0.0007943	0.000529	1.50	0.1358	9.0691718
Overall Satisfaction	0.0470853	0.040069	1.18	0.2422	1.0918037

With Total Degree Centrality – Social removed, three measures remained significant – Cognitive Similarity 2 to the .001 level, In Inverse Closeness Centrality –

Study to the .05 level, and Katz Centrality –Study to the .05 level. The R^2 and Adjusted R^2 were 14.4% and 10.9%, respectively.

Next, the two non-significant measures (Triad Count – Social and Overall Satisfaction) were removed from the model, with the least significant measure being removed first. The final model, shown in Table 4.5, identifies the three significant predictors of GPA difference. Cognitive Similarity -2 is significant to the .001 level while In Inverse Closeness Centrality – Study and Katz Centrality – Study are both significant to the .05 level. The R^2 is 12.8% while the R^2 Adjusted is 10.7%. The Durbin Watson test statistic is 1.96 showing no autocorrelation.

Table 4.5.

Final regression model

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	VIF
Intercept	-0.202142	0.143817	-1.41	0.1623	.
CognitiveSimilarity-2	1.6531963	0.468259	3.53	0.0006*	1.0012582
InInverseClosenessCentrality-Study	-1.898677	0.748027	-2.54	0.0123*	2.5869333
KatzCentrality-Study	1.2100217	0.514008	2.35	0.0201*	2.5849661

The researcher also ran a hierarchical linear model. However, no second order effects were observed. As a result, the analysis was stopped after a straight regression was completed.

Summary

Network descriptive statistics (density, components, and cliques) begin to tell the story of a network. In the LLC studied here, three networks (social, advice, and study)

were observed and measured. By measuring "whom do you know or socialize with" at the beginning and at the end of the semester, changes in the social network were observed. Density increased from .007 to .123 over the course of the semester. As expected, the social network component counts merged, and a disconnected network evolved into a connected network as evidenced by the 27 isolates, 13 dyads, 2 triads, and 3 network structures with four or more nodes merging into one connected network. In addition, cliques increased from 8 to 952 as the social network evolved across the semester.

The advice and study networks, measured at the end of the semester, were not very dense as demonstrated by density measurements of .018 and .027, respectively. Based on their component counts both networks were disconnected. The advice network consisted of 13 isolates, one dyad, zero triads, and one network of four or more connected nodes, while the study network was slightly more connected with 9 isolates, 2 dyads, and one network of four or more connected nodes. The advice network contained 48 cliques while the study network consisted of 108 cliques.

The social network Newman groupings revealed interesting results. With respect to a student SELIs, three of the four social Newman groups consisted of students who exceeded their SELI scores. Of these three groups, more than twice as many students exceeded their SELIs in two groups while the small third group consisting of only five students was almost equally divided between students who exceeded their SELIs (three) and students who underperformed (two). The one social Newman grouping where a

majority of students underperformed their SELI scores was closely split, with 18 students exceeding their SELIs and 21 underperforming.

The advice network consisted of 12 Newman groupings. In eight of the groupings, more students exceeded their SELI scores than did not achieve them. In only three Newman groups did students who underachieved their SELI scores outnumber the students who exceeded them. There was only one grouping where the number of students who exceeded their SELIs equaled the number of students who underperformed.

Of the six study Newman groupings three groups consisted of more students who exceeded their SELI scores, while the remaining groups consisted of more students who underachieved their SELI scores.

It was interesting to note that the Newman groupings of all three networks (social, advice and study) groups were not very heterogeneous as each grouping in each network was either mostly male or female. Living arrangements (each floor of the residence hall accommodated males or females) may have contributed to this result.

Of the 70 network measures computed by ORA, the statistical analysis revealed three significant network measures: cognitive similarity, inverse closeness centrality – study, and Katz centrality – study. These network measures explain 13% of the linear model. The next chapter will discuss the meaning of each significant network measure as well as the implications for students, practitioners, and scholars.

CHAPTER V

DISCUSSION

Research indicates that participating in a living learning community (LLC) promotes or contributes to retention and academic achievement. The purpose of this study was to determine what, if any, networks or network measures contribute to increased academic achievement in an LLC. This chapter addresses each research question and provides implications resulting from the findings for students, practitioners, and scholars.

Research Questions

Network Descriptive Statistics

The first research question asked how network density, component statistics (isolates, dyads or pairs, triads, and larger groupings), and cliques developed and evolved over the course of the semester.

The results indicated that density was not as high as expected for any of the three networks, social, advice, or study. With many students taking the same courses and living in the same residence hall, the researcher expected denser social and study networks. More specifically, as the first semester began, the social network started with a density of. This network density value is greater than zero since some students requested specific roommates in the residence halls. At the beginning of the next semester, the social network density increased to .123. The density of the advice network, measured at the beginning of the second semester, exhibited the smallest density of the three networks at .018. This small value may be attributable to students going outside the LLC for

advice (i.e. to academic advisors, residence hall advisors, fraternity or sorority members, faculty members, etc.). The density of the study network was unexpectedly small especially in light of the fact that the students take many of the same courses during their first semester. This lack of network density development most probably is the result of the short length of the observation period. The researcher administered the initial survey at the start of the fall semester and the follow-up surveys at the start of the spring semester, allowing only a 15-week network gestation period. It seems that network development may need more time to develop academic achievement predictors.

The results also indicated that the social network evolved from a disconnected to a connected network. When the LLC began, survey results reported 27 isolates (single individuals not connected to anyone in the LLC), 13 dyads (pairs of individuals not connected to anyone else in the LLC), 2 triads (three connected individuals not connected to anyone in the LLC), and one larger grouping connecting all remaining individuals. Wasserman and Faust (1994) call this network structure a disconnected graph since it involves subsets of connected nodes not connected to other connected nodes in the graph. During the semester, a number of LLC-specific social events, a community service experience, and various workshops allowed the social network to evolve. This evolution supports student development theory and retention initiatives. Social network cliques increased from 8 at the start of the first semester to 952 by its end, evidence that students forged social relationships during their first semester. Of the three networks (social, advice, and study), the social network progressed or evolved the most across the semester. This observation was expected.

The component composition of the study network was determined by analyzing the data from the follow-up survey administered at the beginning of the students' second semester. The results revealed a disconnected graph consisting of nine isolates, two dyads, and zero triads. The remaining students in this network were all linked in one larger subset. The nine isolates consisted of three pre-business students and six students from other majors. Of the three pre-business students, one had a positive GPA difference (overachieved their SELI) while two had negative GPA differences (underachieved their SELIs). The nine isolates consisted of six females and three males. The dyads were comprised of all females from different majors, all of whom had positive GPA difference values. There were 108 cliques in the study network. Other than the previously mentioned possible limitations caused by the relatively short duration of the study, the researcher drew no conclusions from the study network.

The researcher evaluated the component composition of the advice network from data collected from the follow-up survey administered at the beginning of the second semester. This network consisted of 13 isolates, 1 dyad, zero triads, and 1 larger grouping connecting all of the remaining individuals. The 13 isolates contained seven pre-business and six students from other majors. Three of the seven pre-business students achieved positive GPA difference scores while the remaining four earned negative GPA difference scores. In this same group of 13 isolates, ten were male and three were female students. The dyad was composed of two students from different majors, both of whom achieved a positive GPA difference. There were 48 cliques in the advice network. While it is interesting to note that most of the isolates were males, the

researcher drew no conclusions from the advice network. As in the other networks, the relatively short study duration could have limited the development of this network.

One final observation is the fact that expected network characteristics like Simmelian ties (three-way reciprocal connections) were not detected in the component make-up of the network. These ties are particularly predictive of such things as innovation (Tortoriello & Krackhardt, 2010). An observation period longer than 15 weeks may have generated this network structure.

Newman Groupings

The second research question asks what social, advice, and study networks, as identified by Newman groupings, developed over the course of the semester. Newman groupings finds clusters of nodes that are unusually dense or that communicate among themselves more than with nodes outside the group (Carley, Pfeffer, Reminga, Storrick, & Columbus, 2013). The researcher used the student's (SELI), gender, and academic major attributes to determine Newman groupings within the LLC's social, advice, and study networks.

Social Network Newman Grouping. With respect to a student's GPA difference in the four social Newman groups, no group demonstrated a proclivity for doing better or worse than the other three. Three of the four groups exceeded their SELIs while one group did not. Interestingly, there was a lack of gender heterogeneity in the clusters. Two of the groupings were primarily male (37 male and 2 female; 34 male and 0 female) while two were primarily female (49 female and 4 male; 4 female and 1 male). As

campus housing assigns rooms by floor and by gender, it highly likely that this room assignment policy contributed to this Newman grouping structure.

Advice Network Newman Grouping. There were 12 advice Newman groupings. Of these twelve, only three consisted of more students who underachieved their SELIs than overachieved them. Of the three underperforming groups, two consisted of all males while one consisted of all females. There were five all-male groups, three of which overachieved their SELIs while two did not. There were two all-female groups, with one overachieving its SELI while the other underachieved it. Only one group consisted of students in the same major, all-male pre-business students. This group, as a whole, underperformed its SELI. The researcher drew no conclusions from the advice Newman grouping.

Study Network Newman Grouping. Because the LLC students took many of the same courses together and could study together, the researcher expected each Newman grouping to contain more students who exceeded their SELIs than students who did not. However, of the six total study Newman groups formed, only one group, group C, met this expectation. In this group, 25 students earned a GPA above their SELIs while 11 earned a GPA below their SELIs. In the remaining five groups, the distribution of students who exceeded and who underachieved their SELIs was almost equally divided within each group. Specifically, Group A consisted of 7 students who exceeded their SELIs while 6 did not; in Group B, 1 student exceeded his/her SELI while 2 did not, and in Group D, 5 students exceeded their SELIs while 6 did not. In addition, Group E consisted of 17 students who exceeded their SELIs while 18 did not, and Group F

consisted of 2 students who exceeded their SELIs while 1 did not. The same gender distribution, with groups consisting of primarily males or females, found in the social network Newman grouping also occurred in the study network grouping. It is highly probable that the room assignment policy previously discussed also contributed to this gender distribution.

Network Measures

The final research question asks what ORA-derived network measures predicted positive academic performance when compared to a student's predicted GPA. ORA produced 70 agent level measures. Following statistical analysis and model development using JMP software, three significant measures emerged using the student's GPA difference, computed by subtracting the students' SELIs (projected GPAs) from their actual earned GPAs, as the dependent variable. A positive GPA difference meant a student overachieved or did better than the admissions model prediction. The three significant variables, cognitive similarity, in inverse closeness centrality – study, and Katz centrality – study, are discussed below.

Cognitive Similarity. The most significant measure, at the 0.001 level ($t = 3.53$), was cognitive similarity, which measures how many pairs of agents have overlapping knowledge (Carley, et al. (2013). It is likely that students with high positive GPA difference scores (students who exceed their projected GPA differences) will self-identify, form friendships, trust, hold the same belief patterns, study together, and are similar to others with high positive GPA difference scores. Cognitive similarity is a measure of homophily, or the notion that similar agents are more likely to interact than

dissimilar agents are likely to interact. McPherson, Smith-Lovin, and Cook (2001) argue that like agents are more productive than unlike agents, and this result appears to support that assertion.

In Inverse Closeness Centrality – Study. The second significant measure was in inverse closeness centrality ($t = -2.54$, $p = 0.01$). Closeness centrality is the inverse of the average distance between a node in a network and all other nodes in the network (Carley, et al., 2013). This measure is the sum of the geodesic distances (number of steps) from one node to all other nodes in the network based on the shortest path (Scott & Carrington, 2011; Borgatti, Everett, & Johnson, 2013; Robins, 2015; Wasserman & Faust, 1994). Nodes with a high closeness centrality (which is essentially the same concept as inverse closeness centrality) scores are more likely to operate more efficiently and communicate faster (Carley, et al. (2013). In inverse closeness centrality, then, measures how close individuals in the network are to others in the network and the consequent speed with which they interact.

However, in inverse centrality differs from closeness centrality in two ways. As the former is the inverse of closeness centrality, small numbers for inverse centrality indicate the given node is more central to the network and can obtain information more quickly than individuals with larger closeness centrality scores (Carley, et al., 2013; Wasserman & Faust, 1994; Borgatti, Everett, & Johnson, 2013; Borgatti, 2005; Hanneman & Riddle, 2011; Carolan, 2014). The "in" portion of this measure refers to closeness of individuals based on connections into that person, but it does not count links that the given person initiated.

An interesting aspect of in inverse closeness centrality is that this coefficient has a negative relationship with GPA difference. Individuals with small coefficients for in inverse closeness centrality are closer to others than are individuals with large numbers; this negative value, then, indicates individuals who are more central to the network or have more and closer connections in the network experience a positive impact on their SELI scores.

Katz Centrality – Study. Katz centrality, which was also significant ($t = 2.35$, $p = 0.02$), measures the relative influence of an agent in a social network. This measure is computed by determining the total number of walks between a pair of agents. Katz is similar to closeness except that it includes straight lines, circuitous routes, and revisit walks (Borgatti, 2005; Hanneman & Riddle, 2011; Katz, 1953). While closeness centrality looks only at direct links, Katz centrality measures all links (close and long links). As a result, the conclusions for Katz centrality are similar to those for in inverse closeness centrality: based on both measures, students who are close to many other students will have high GPA difference scores, and vice versa. Overall, the results indicate that students who exceed their projected GPA differences will form friendships, trust, hold the same belief patterns, study together, and are similar to others with high positive GPA difference scores, and they are close (in number of steps) to many other students.

Variable Clustering. An additional tool available to study networks is variable clustering analysis. This technique identifies groups of closely related measures or sets of measures that closely correlate with one another (Sall, Lehman, Stephens, &

Creighton, 2014; Wasserman & Faust, 1994; Norusis, 2012; Scott, 2013). Analyzing the clusters where the three significant measures are found allows researchers to further understand the results. Applying variable clustering to the study data revealed seven clusters. The three significant measures were located in two of these seven clusters. Table 5.1 presents the results of the variable cluster analysis.

Table 5.1.

Variable cluster analysis results

Significant Measure:	Clustered with:
Cognitive Similarity	Cognitive Demand Cognitive Distinctiveness Cognitive Resemblance Cognitive Expertise
Katz Centrality – Study In Inverse Closeness Centrality	Column Degree Centrality – Study Eigenvector Centrality – Study Clique Count – Study Structural Holes Effective Network Size – Study

The first significant network measure in this study, cognitive similarity, is found in the same cluster as cognitive demand, cognitive distinctiveness, cognitive resemblance, and cognitive expertise. A cognitive social structure identifies who is connected to whom within the network. This structure refers to measures that identify cognitive relationships as cognitive demand, distinctiveness, resemblance, and expertise. This network structure measures perceptions of the entire network by asking respondents about their ties to other respondents within the network (Scott & Carrington, 2011; Borgatti, Everett, & Johnson, 2013; Robins, 2015; Wasserman & Faust, 1994). Cognitive demand, a measure in this cluster, measures the amount of effort members in the network

use to communicate and do their work. Individuals with high cognitive demand are in high demand since they are well connected socially and possess much knowledge. They typically develop into network leaders, and, as a result, if removed cause disruption in the network (Carley, et al., 2013). Cognitive distinctiveness measures how much pairs of individuals in the network have complementary or opposite knowledge (Carley, et al., 2013). These pairs have distinct, different or unusual knowledge in the network. The next measure in this cluster, cognitive resemblance, measures pairs of individuals who are a lot alike and possess the same knowledge, thus promoting homogeneity and network similarity (Carley, et al., 2013). The final measure in this cluster, cognitive expertise, measures the complementary knowledge within a pair of individuals in a network as stated in terms of the knowledge of the first individual (Carley, et al., 2013).

Since cognitive social structures measure who is connected to whom in the network, it makes sense that the significant measure cognitive similarity is clustered with other cognitive social structures – demand, distinctiveness, resemblance, and expertise. Students with high GPA difference scores associate with students with related or overlapping information, students in high demand due to their social connections and knowledge, and students with complementary and opposite knowledge and expertise. All of these types of interactions promote higher GPAs and, thus, higher, positive GPA differences.

The remaining two significant measures, Katz Centrality – Study and In Inverse Closeness Centrality, were located in the same cluster. The other measures in this cluster included column degree centrality – study, eigenvector centrality – study, clique count –

study, and structural holes effective network size – study as shown in Table 5.1. Carley, et al. (2013) equates column degree centrality with in-degree centrality, which measures the number of connections an individual receives from other individuals (likewise, in inverse closeness centrality evaluates in degree links). Eigenvector centrality is a measure of influence or popularity, with individuals with high scores being connected with others who are also well connected or in the center of things (Borgatti, Everett, & Johnson, 2013; Robins, 2015; Grassi, Stefani, & Torriero, A, 2007). On the other hand, individuals with low eigenvector centrality scores are connected to many isolated individuals in an organization. Carley, et al. (2013) relate eigenvector centrality to clique leadership. Leaders of cliques within a network are connected to other highly connected individuals. These researchers maintain that the individual in a clique most connected to others in the clique, as well as connected to other cliques, is the leader. Additionally, individuals with high eigenvector scores are important for quick communications (Carley, et al., 2013).

The second measure in this cluster is clique count, which is defined as the number of distinct cliques to which an individual belongs. A clique is a group of three or more individuals who have connections to one another but few connections outside that group, meaning individuals in cliques talk more to people in their clique than people outside of their clique (Carley, et al., 2013; Borgatti, Everett, & Johnson, 2013; Robins, 2015).

The final measure in this cluster is structural holes effective network size, defined by Bart (1992) as gaps in information flows. Individuals on either side of the structural

hole have access to different information flows. Thus, these individuals connect cliques and triads and receive information from those areas of the network.

It seems consistent that Katz centrality and in inverse closeness centrality appear in the same cluster since both variables measure the closeness of individual connections in the network. The connections and information flow resulting from those connections is significant for academic achievement. The measures located in the same cluster also support these significant measures. Column degree centrality (in degree centrality) measuring the number of connections from others, eigenvector centrality measuring the influence and popularity of individuals in the network, and clique count measuring the distinct numbers of cliques individuals belong to all point to the significance of connections in the network for academic achievement. Further, structural holes identify the importance of bridging the information gaps in the network, ensuring information continues to flow throughout the network.

Coefficient of Determination (R^2). Another network measure to consider in this model is the coefficient of determination or R^2. This statistical measure ascertains how much of the variation of the dependent variable is explained by a linear model (Field, 2014; Norusis, 2012). The R^2 for this model is 12.85%, with the three significant variables from this study explaining this moderate amount of variation. The R^2 found in this study is consistent with the same explanatory power found in Briley's (2016) test score growth over a one-year period. In Briley's study, the growth R^2 ranged from 3% to 6% but this study occurred over a longer period (one year versus a 15-week study used in

this research). The researcher expects that a higher R^2 is possible if the study had occurred over a year instead of the 15 weeks allocated to it.

Implications

This LLC research has implications for students, practitioners, and scholars. This section identifies and analyzes these implications for these constituent groups.

Implications for Students

This research identifies two implications for students. The first implication, as revealed by the significant variable, cognitive similarity, is that students with high, positive GPA difference scores (students who exceed their projected GPA differences) will self-identify, form friendships, trust, hold the same belief patterns, study together, and are similar to others with high, positive GPA difference scores. Cognitive similarity is a measure of homophily, or the notion that similar agents are more likely to interact than dissimilar students are likely to interact.

This scenario is also visible in the cluster analysis where cognitive similarity is clustered with cognitive demand, cognitive distinctiveness, cognitive resemblance, and cognitive expertise. Students tend to associate with other students who have the same information, are in high demand due to their social connections and knowledge, and those with complementary knowledge and expertise. As a result, students should seek to form friendships and study groups with other LLC members who are very much like themselves in academic abilities and beliefs. By seeking out these relationships, students with like abilities complement each other while studying instead of potentially "tutoring"

students with less ability. The result is more quality time increasing their own knowledge rather than assisting students with fewer skills.

The second implication is that students with high GPA difference scores are well connected within the network. These connections provide faster access to information across the network. This implication is revealed by the significant variables Katz centrality – study and in inverse closeness centrality, both of which indicate that students with high connections achieve higher GPA scores than students with low connectivity across the network.

These two significant variables are clustered with four very similar network variables supporting this implication. The first variable in this cluster is column degree centrality – study (a concept similar to in degree centrality) that details the number of connections a student receives from others. The second variable is eigenvector centrality – study that measures the influence and popularity of a student in the network. The third variable is clique count – study, which identifies the number of cliques to which an individual belongs. The final variable in this cluster, structural holes effective network size – study, identifies the individuals who connect cliques and triads within the network, thus having access to different information in the network. All of the variables in this cluster point to the connectivity of the student within the network and the resultant academic success as expressed in the high GPA difference associated with this connectivity. Students should strive to establish many connections within the network with students with like abilities and beliefs, using them to further their academic achievement. Increasing these connections within the network will also allow students to

know the network high achievers in order to form the right study groups to increase their academic achievement.

Implications for Practitioners

All three Newman groupings (social, advice, and study) showed a definite separation by gender, most likely caused by the residence hall room assignments. The campus housing office assigned students in this residence hall based on gender and by floor. In this case, campus housing assigned females to the first and second floor and males to the third. The LLC's residence hall consists of two-person rooms with a central bathroom on each floor. On any given day, room doors are left open, allowing free flow of conversation as student walked through the facility. This open door "policy" facilitated interactions among residents on each floor. However, it does not appear to promote interactions between the floors.

A suite style residence hall may further restrict interactions to suitemates only, a situation could have a negative impact on network activity and academic achievement as well. If the purpose of an LLC is to promote interactions between larger numbers of students, practitioners should consider the residence hall configuration (traditional vs. suites style) when locating an LLC. Since this study determined networking is important for achieving high academic performance, practitioners should seek a residence hall for their community that facilitates networking.

Regardless of the residential hall configuration, practitioners should actively facilitate networking and other opportunities to encourage students within the LLC to meet and mix throughout the program. These interactions could allow residents the

opportunity to extend their network thus better familiarizing themselves with like beliefs and abilities to augment their study groups in order to have a positive impact on their earned GPA.

Practitioners can take this analysis a step further by identifying individual students who are not very well connected in the LLC network. The "All Measures Report," from ORA provides network measures for each student in the network. Practitioners can evaluate this report, identify students who are not well connected in the network, and assist them in developing these connections. Establishing and nurturing these connections would allow access to more resources within the network that could facilitate forming useful study groups, resulting in increased academic achievement, and retention.

Implications for Scholars

Previous research indicated that participating in an LLC promotes or contributes to retention and academic achievement. Since an LLC is a network of students, this study was completed in an attempt to determine what, if any, specific network characteristics or measures contributed to academic achievement. This study revealed certain measures, specifically, cognitive similarity, Katz centrality, and in inverse closeness centrality, were significant in increasing academic performance in the LLC. However, this study only begins to explore and discover how student interactions within an LLC network contribute to student success. While its results suggest that certain network measures do affect academic performance, longer studies can further these conclusions.

Networking based on residence hall configurations also needs further study. The move to suite-style residence hall configurations may, while potentially more attractive to students, stifle networking and academic performance. This study did find a definite limit to networking based on gender caused by room assignments by floor.

Limitations and Future Study

This LLC was examined for only one semester. Following data analysis, the researcher concludes that many network interactions and measures may not have had enough time to fully develop over this relatively short 15 weeks. Additional studies should measure interactions for at least a year or as long as the LLC exists. For longer studies, it would also be beneficial to make intermediate observations (i.e., at the end of each semester) to further observe the network as it develops over time.

The results of longer studies should also compare the results of more homogeneous groups with respect to academic majors. While the cohort studied here consisted of a majority of pre-business and behavioral science students, the study also included students with no academic ties (i.e., taking the same courses) to the community. Future studies of a more homogeneous LLC with more homogeneous goals may determine additional and more significant measures, allowing further refinements in the LLC goals, objectives, and events to promote additional academic success.

Longer studies with different cohorts of various homogeneous students (i.e., engineering students, first-year minority students, and first-generation college students, for example) would allow further comparisons to determine what measures are most important for promoting academic success in those specific communities. For example,

engineering LLCs may provide additional access to tutoring for their STEM courses, while first-generation college students may need additional workshops to aid in their academic success.

Another aspect to consider is adding a qualitative aspect to similar research. Adding such a narrative may provide additional insight, perspective, and richness to the results of the statistical analysis.

Residence hall arrangements have changed over time from the traditional two-person rooms with communal bathrooms to suite style configurations. Future studies could compare and contrast academic achievement and network variables for these configurations.

Summary

While this study did not generate the network density and characteristics a longer study could have, it did generate noteworthy implications for students, practitioners, and scholars. A longer study over two semesters could provide an opportunity for a mid-point correct between semesters and a final evaluation period at the end of the second. Researchers can and should complete additional studies with these foci.

APPENDICES

Appendix A

Exploratory Survey

1. (Resource) What campus academic resources did you use during the last semester?

   Possible answers could include Academic Success Center Tutor, roommate, someone in the Living Learning Community, classmate outside the living learning community, Living Learning Leadership Committee, academic advisor, housing representatives (RA), library, etc.

2. (Resource) What campus social resources or events did you use/attend during the last semester?

   Possible responses could include Fike, Living Learning Community events (faculty dinner, Y Beach outing, White Water Rafting, Bowling, Movie Night, and Cookie Social events), football games, basketball games, etc.

3. (Knowledge) What specialized skills do you believe you brought to Clemson that helped you succeed academically during your first semester?

   Possible answers could be math skills, social skills, personality, extrovert, introvert, problem solving skills, previous college work (dual enrollment), etc.

4. (Knowledge) What do you believe you are good at doing from an academic perspective?

   Possible answers are I am good at math, science, writing, art, solving problems, etc.

Appendix B

Responses to Exploratory Survey Question 1

What campus academic resources did you use during the last semester?

Supplemental Instruction	Library study spaces
Academic Success Center Tutors	Sirrine study spaces
Academic Success Center Workshops – notetaking, writing, study skills, etc.	Benet Hall study spaces
Academic Success Center Coaches	Academic Success Center study spaces
Academic Advising Center	Students outside the LLC
Career Center	Benet Resident Assistant
Honors Center/Mentor	Studied own your own
BUS 1010 Course	Parents
CUBBS Living Learning Community Workshops	Professors – e-mailed, office hours, after class, etc.
Engineering Undergraduate Teaching Assistants/Tutors	Fraternity
Other Benet Hall residents – covers roommates, LLC study groups, other LLC students, etc.	Sorority
Benet Graduate Community Director	

Appendix C

Responses to Exploratory Survey Question 2

LLC sponsored social events – covers dinner with faculty, tailgate, study break pizza, Y Beach, Move-in BBQ, Carillion Bells, Planetarium, Bowling, Corn Hole Tournament, Cookie Social, and community service
Benet Resident Assistant
Benet Graduate Community Director
Attending Clemson NCAA sports events – covers football, basketball, soccer, etc.
Participating in Clemson NCAA sports
Attending Clemson non-NCAA sports clubs
Participating in Clemson non-NCAA sports clubs
Participating in Intramural sports
Participating in Clemson non-sports organizations and clubs
Central Spirit
Fike Recreational Center
Greek Life – Fraternity
Greek Life – Sorority
Other Living Learning Communities (Peer, WISE, etc.)
Tigerama
Tiger Ties
Freshman Council
Campus Ministry
Gay Straight Alliance social events
Student Government

Appendix D

Responses to Exploratory Survey Question 3

Good study skills and strategies
Completed AP/IB/Dual enrollment classes in high school
Extroverted
Detail oriented
Prepare prior to class
Good at understanding topics and restating or explaining them
Organization skills
Time management skills
Work ethics
Staying on task/focused
Communication skills with other students
Communication skills with professors
Critical thinking
Leadership skills
Good at asking questions
Reliable
Quick thinker
Determined
Listening skills in class
Good note taker
Self-motivator
Willing to ask for assistance
Collaboration skills/working with others

Appendix E

Responses to Exploratory Survey Question 4

Reading
Math/numbers
History
Well rounded in academics
Government classes
Problem solving
Asking questions
Writing
Psychology
Quick thinking
English
Liberal arts
Science classes
Economics
Languages
Public Speaking
Abstract thinking
Accounting

Appendix F

Initial Survey Questions and Qualtrics Parameters

Survey Item	Survey Parameters
1. From the list of Living Learning Community (LLC) members listed below, **select your name**. List LLC students	- Multiple Choice - 131 choices - Single Answer - Column - 9 columns - Force response - No validation
2. Select your gender. Male/Female	- Multiple Choice - 2 choices - Single Answer - Horizontal - Label above - No force response - No validation
3. Prior to arriving on campus, who of the following LLC students did you know or socialize with? Select all applicable names. List LLC students	- Multiple Choice - 131 choices - Multiple Answer - Column - 9 columns - No force response - No validation
4. (Belief) I believe that participating in the CUBBS Living Learning Community will have a positive impact on my first semester at Clemson. Seven point Likert agreement Scale: 1. Strongly disagree 2. Disagree 3. Somewhat disagree 4. Neither agree or disagree 5. Somewhat agree 6. Agree 7. Strongly agree	- Matrix Table - 1 statements - 7 scale points - 0 labels - Likert - Single answer - Mobile friendly - Force response - No validation

5. (Belief) I believe that participating in the CUBBS Living Learning Community (LLC) will make my transition to Clemson easier. Seven point Likert <u>agreement</u> Scale: 1. Strongly disagree 2. Disagree 3. Somewhat disagree 4. Neither agree or disagree 5. Somewhat agree 6. Agree 7. Strongly agree	- Matrix Table - 1 statements - 7 scale points - 0 labels - Likert - Single answer - Mobile friendly - Force response - No validation
6. (Belief) I intend to remain at Clemson until I complete my undergraduate degree. Seven point Likert <u>agreement</u> Scale: 1. Strongly disagree 2. Disagree 3. Somewhat disagree 4. Neither agree or disagree 5. Somewhat agree 6. Agree 7. Strongly agree	- Matrix Table - 1 statements - 7 scale points - 0 labels - Likert - Single answer - Mobile friendly - Force response - No validation

7. (Knowledge) What specialized skills do you believe you bring to Clemson that helped you succeed academically during your first semester? Select all that apply. Good study skills and strategies Completed AP/IB/Dual enrollment classes in high school Extroverted Detail oriented Prepare prior to class Good at understanding topics and restating or explaining them Organization skills Time management skills Work ethic Staying on task/focused Communication skills with other students Communication skills with professors Critical thinking Leadership skills Good at asking questions Reliable Quick thinker Determined Listening skills in class Good note taker Self-motivator Willing to ask for assistance Collaboration skills/working with others <u>NOTE</u>: Responses originated from exploratory survey.	- Multiple Choice - 23 choices - Multiple Answers - Column - 6 columns - No forced response - No validation

8. (Knowledge) What do you believe you are good at doing from an academic perspective? Select all that apply. Reading Math/numbers History Government classes Psychology English Liberal arts Science classes Economics Languages Accounting Well rounded in academics Quick thinking Problem solving Asking questions Writing Public Speaking Abstract thinking NOTE: Responses originated from exploratory survey.	- Multiple Choice - 18 choices - Multiple Answers - Column - 6 columns - No forced response - No validation

Appendix G

Follow-up Survey Questions and Qualtrics Parameters

Survey Item	Survey Parameters
1. From the list of Living Learning Community (LLC) members listed below, **select your name**. List LLC students	- Multiple Choice - 131 choices - Single Answer - Column - 9 columns - Force response - No validation
2. (Knowledge) What specialized skills do you believe you brought to Clemson that helped you succeed academically during your first semester? Select all that apply. Good study skills and strategies Completed AP/IB/Dual enrollment classes in high school Extroverted Detail oriented Prepare prior to class Good at understanding topics and restating or explaining them Organization skills Time management skills Work ethic Staying on task/focused Communication skills with other students Communication skills with professors Critical thinking Leadership skills Good at asking questions Reliable Quick thinker Determined Listening skills in class Good note taker Self-motivator Willing to ask for assistance Collaboration skills/working with others NOTE: Responses originated from exploratory survey.	- Multiple Choice - 23 choices - Multiple Answers - Column - 3 columns - No forced response - No validation

3. (Knowledge) What do you believe you are good at doing from an academic perspective? Select all that apply. Reading Math/numbers History Government classes Psychology English Liberal arts Science classes Economics Languages Accounting Well rounded in academics Quick thinking Problem solving Asking questions Writing Public Speaking Abstract thinking <u>NOTE</u>: Responses originated from exploratory survey.	- Multiple Choice - 18 choices - Multiple Answers - Column - 3 columns - No forced response - No validation
4. Whom of the following LLC students **<u>did you socialize with</u>** during the fall semester? Select all who apply. List LLC students	- Multiple Choice - 131 choices - Multiple Answers - Column - 9 columns - No forced response - No validation
5. Whom of the following LLC students **<u>did you study with</u>** during the first semester? Select all who apply. List LLC students	- Multiple Choice - 131 choices - Multiple Answers - Column - 9 columns - No forced response - No validation

6. Whom of the following LLC students **did you go to for advice** during the first semester? Select all who apply. List LLC students	- Multiple Choice - 131 choices - Multiple Answers - Column - 9 columns - No forced response - No validation
7. Whom of the following LLC students **came to you for advice** during the first semester? Select all who apply. List LLC students	- Multiple Choice - 131 choices - Multiple Answers - Column - 9 columns - No forced response - No validation

8. (Resource) What **<u>campus academic resources</u>** did you use during the fall semester? Select all that apply. Supplemental Instruction Academic Success Center Tutors Academic Success Center Workshops – notetaking, writing, study skills, etc. Academic Success Center Coaches Academic Advising Center Career Center Honors Center/Mentor BUS 1010 Course CUBBS Living Learning Community Workshops Engineering Undergraduate Teaching Assistants/Tutors Library study spaces Sirrine study spaces Academic Success Center study spaces Benet Hall study spaces Other Benet Hall residents – covers roommates, LLC study groups, other LLC students, etc. Students outside the LLC Professors – e-mailed, office hours, after class, etc. Studied own your own Parents Benet Resident Assistant Benet Graduate Community Director Fraternity Sorority <u>NOTE</u>: Responses originated from exploratory survey.	- Multiple Choice - 23 choices - Multiple Answers - Column - 2 columns - No forced response - No validation

9. (Resource) What **campus social resources or events** did you use or attend during the fall semester? Select all that apply. LLC sponsored social events – covers dinner with faculty, tailgate, study break pizza, Y Beach, Move-in BBQ, Carillion Bells, Planetarium, Bowling, Corn Hole Tournament, Cookie Social, and community service Benet Resident Assistant Benet Graduate Community Director Attending Clemson NCAA sports events – covers football, basketball, soccer, etc. Participating in Clemson NCAA sports Attending Clemson non-NCAA sports clubs Participating in Clemson non-NCAA sports clubs Participating in Intramural sports Participating in Clemson non-sports organizations and clubs Central Spirit Fike Recreational Center Greek Life – Fraternity Greek Life – Sorority Other Living Learning Communities (Peer, WISE, etc.) Tigerama Tiger Ties Freshman Council Campus Ministry Gay Straight Alliance social events Student Government NOTE: Responses originated from exploratory survey.	- Multiple Choice - 20 choices - Multiple Answers - Column - 2 columns - No forced response - No validation

10. (Belief) To what extent do you agree or disagree with the following six belief statements? I believe that participating in the CUBBS Living Learning Community had a **positive impact on my first semester** at Clemson. I believe that participating in the CUBBS Living Learning Community (LLC) made my transition to Clemson easier. I intend to remain at Clemson until I complete my undergraduate degree. I am satisfied with the **support** I received from the CUBBS LLC. I believe the CUBBS LLC provided for my **academic needs**. I believe the CUBBS LLC provided for my **social needs**. Seven point Likert agreement Scale: 1. Strongly disagree 2. Disagree 3. Somewhat disagree 4. Neither agree or disagree 5. Somewhat agree 6. Agree 7. Strongly agree	- Matrix Table - 6 statements - 7 scale points - 0 labels - Likert - Single answer - Mobile friendly - Force response - No validation
11. (Belief) The LLC is structured to provide students with informational workshops or opportunities in four areas: academic goals, personal and professional goals, leadership skills, and community involvement. Which area do you believe you benefitted the most from in your first semester? Answers would be one of the four areas cited. 1. Academic goals 2. Personal and professional goals 3. Leadership skills 4. Increasing your community involvement	- Multiple Choice - 4 choices - Single answer - Column - 2 columns - Force response - No validation

12. (Belief) To what extent do you agree or disagree with the following four belief statements? I believe the CUBBS LLC informational workshops or opportunities assisted me in meeting my **academic goals** (for example: Dinner with the Dean, Time Management and Financial Literacy Seminar, and Faculty Dinner). I believe the CUBBS LLC informational workshops or opportunities assisted me in meeting my **personal and professional goals** (for example: Campus Involvement and OSE Overview seminar, Dinner with the Dean, Time Management and Financial Literacy Seminar, Sleep Habits and Chick-fil-A Seminar, Faculty Dinner, and the I LEAD and Wendy's Seminar). I believe the CUBBS LLC informational workshops or assisted me in meeting my **leadership skills goals** opportunities (for example: Dinner with the Dean, and the I LEAD and Wendy's Seminar). I believe the CUBBS LLC informational workshops or opportunities assisted me in increasing my **community involvement** (for example: National Hunting and Fishing Day and the Botanical Gardens Event). Seven point Likert agreement scale. 1. Strongly disagree 2. Disagree 3. Somewhat disagree 4. Neither agree or disagree 5. Somewhat agree 6. Agree 7. Strongly agree 8. N/A – Did not attend any workshops or opportunities in this area. NOTE: There is an N/A choice since a student may not have attended any workshops or opportunities in this area.	- Matrix Table - 4 statements - 8 scale points - 0 labels - Likert - Single answer - Mobile friendly - Force response - No validation

Appendix H

ORA Parameters Imported into JMP Software

Brokerage - Advice	Ego Betweenness Centrality - Advice
Brokerage - Social	Ego Betweenness Centrality - Social
Brokerage - Study	Ego Betweenness Centrality - Study
Clique Count - Advice	Eigenvector Centrality - Advice
Clique Count - Social	Eigenvector Centrality - Social
Clique Count - Study	Eigenvector Centrality - Study
Closeness Centrality - Advice	In Inverse Closeness Centrality - Advice
Closeness Centrality - Social	In Inverse Closeness Centrality - Social
Closeness Centrality - Study	In Inverse Closeness Centrality - Study
Clustering Coefficient, Density - Advice	Information Centrality - Social
Clustering Coefficient, Density - Social	Information Centrality - Study
Clustering Coefficient, Density - Study	Inverse Closeness Centrality - Advice
Cognitive Demand - Advice - 1	Inverse Closeness Centrality - Social
Cognitive Demand - Advice - 2	Inverse Closeness Centrality - Study
Cognitive Demand - Advice - 3	Katz Centrality - Advice
Cognitive Demand - Advice - 4	Katz Centrality - Social
Cognitive Demand - Social - 1	Katz Centrality - Study
Cognitive Demand - Social - 2	Shared Situation Awareness - Advice
Cognitive Demand - Social - 3	Shared Situation Awareness - Social
Cognitive Demand - Social - 4	Shared Situation Awareness - Study
Cognitive Demand - Study - 1	Structural Holes Constraint - Advice
Cognitive Demand - Study - 2	Structural Holes Constraint - Social
Cognitive Demand - Study - 3	Structural Holes Constraint - Study
Cognitive Demand - Study - 4	Structural Holes Effective Network Size - Advice
Cognitive Distinctiveness - 1	Structural Holes Effective Network Size - Social
Cognitive Distinctiveness - 2	Structural Holes Effective Network Size - Study
Cognitive Expertise - 1	Structural Holes Efficiency - Advice
Cognitive Expertise - 2	Structural Holes Efficiency - Social
Cognitive Resemblance - 1	Structural Holes Efficiency - Study
Cognitive Resemblance- 2	Total Degree Centrality - Social
Cognitive Similarity - 1	Triad Count - Social
Cognitive Similarity - 2	Triad Count - Study
Column Degree Centrality - Advice	Goal Satisfaction
Column Degree Centrality - Social	Positive Impact
Column Degree Centrality - Study	Overall Satisfaction

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