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An Exploration of a Blended Learning Cohort through Social Network Analysis

A Technical Report to the ELSS Program

Morgridge College of Education, University of Denver

By Kelley C Bliden

May 2014

Abstract

The following technical report is a social network analysis of online threaded discussions from three blending learning cohorts. The purpose of this social network analysis was to explore graduate level blended learning cohorts by investigating how the relationships and interactions among individuals shape and affect the overall cohort, to explore the evolution of each cohort over time, and to investigate facilitator interactions within the blended learning program and how their contributions shaped and affected the network.

The threaded discussions were coded and analyzed based on literature about social network analysis, constructive-developmental theory, holding environments, and transformational learning theory. Eight selected weeks of discussions were coded for each of the three cohorts. All three cohorts remained mostly consistent with the same individuals and the same facilitators throughout the year-long program. The stability of the participants and the facilitators generated social network outcomes from all four quarters of each cohort. In order to confirm the results of the hypothesis of this researcher about constructive-developmentalism and transformational learning within these cohorts, the researcher then cross-referenced with the analysis of another researcher using the same data who conducted a content analysis in ways of knowing. Discussion of the analysis and further recommendations for research has been included in this report.

Acknowledgements

“For I know the plans I have for you,” declares the LORD, “plans to prosper you and not to harm you, plans to give you hope and a future”, Jeremiah 29:11. “We must make a decision to be courageous and commit to the process of growth, which requires hard work and is often painful!”, Milan and Kay Yerkovich. I am grateful for God’s blessing upon my life and His knowledge of my heart, He knows I endeavor to be all He created me to be. It may only take one person to change your life but I have been fortunate to have had several who have had a significant impact in changing mine through this degree and this research.

Thank you to Dr. Linda Brookhart for the many conversations during our advisory sessions which led to the idea of researching blended learning cohorts at a university level. I am grateful for Dr. Susan Korach and Dr. Kristina Hesbol for expanding my thinking, for giving me the individual time with you in order for me to create my own knowledge, and for the encouragement along the way. I am thankful to the kindhearted Becky McClure who supported my research by providing necessary information, answering viable questions, and agreeing to serve on my committee. I am eternally grateful to Dr. Kent Seidel whose never ending support, guidance, encouragement enthusiasm, and occasional humor contributed significantly to my research and education but also to my personal growth.

Each stage of this research could not have been completed without the tremendous support of the future Dr. Lee Morgan, who spent countless hours challenging my thinking in order to produce a greater research product and contributing to the graphs, charts and calculations by giving his time, knowledge and use of his technology.

I am especially grateful to my husband, Christopher Bliden and my two sons Mason Bliden and Kamryn Bliden whose faith and encouragement was never ending. Thank you for

putting up with my countless hours of taking over the kitchen table and having to alter plans so that I could complete this research. Chris, you will never know what it truly means to me for the many times you would drive to the university to bring me something that I needed to make my study day successful, for the times you would encourage me, tell me how you knew I could accomplish anything I set my mind to doing, and for the many times you would tell me how proud you were of me.

My parents, Gary and Sandra Norman who would care for my family and pick up the pieces of my responsibilities while I was absent doing my research. Your hearts and love that would do anything for me was truly representative of the acts of service you gave me during these years in completing my degree.

My incredible research partner, Dr. Dawn McWilliams, whose time, commitment, dedication and immense brainpower is immeasurable. Dawn gave me timeless words of encouragement and support and an environment filled with motivations, brainpower food, and laughter. When a flip of a coin was good enough and having faith we would work hard no matter which method was chosen. I could not have done without the text messages and emails that kept me going when we weren't researching together. I am truly blessed to have found a partner in Dawn shortly into our 3 year program, during our Correlations and Regression class. I am blessed that this partnership grew into a great and successful bond which thankfully continued through our research journey. What an awesome experience it was to be able to create this research together. I am proud to be able to celebrate our accomplishments alongside her at spring commencement. Thank you, Dawn, for everything!

In memory of Kenneth G. DeVries, my grandfather, who died on August 20, 2013 and didn't quite make it to my graduation day. Grandfather, I know that even though you do not

reside on this earth with me anymore, I know you are always with me. It is you who encouraged and supported me to return to school to seek a doctorate degree. If it wasn't for you, I would have never applied to the university. Thank you for having faith in me and pushing me into a great experience that I will carry with me the rest of my life. I will always love you!

Table of Contents

Introduction.....	8
Purpose of the Study.....	8
Background.....	9
Ways of Knowing.....	11
Blended Learning.....	12
Relationships and Interactions.....	12
Social Network Analysis.....	13
Bliden Hypothesis of Social Network Analysis and Ways of Knowing.....	13
Statement of Justification.....	14
Research Questions.....	14
Definition of Terms.....	15
Review of Literature.....	21
Social Constructivism.....	21
Constructive-Developmental Theory.....	23
Incorporative/Impulsive.....	25
Instrumental.....	25
Socializing.....	26
Self-Authoring.....	26
Self-Transforming.....	26
Holding Environments.....	26
Groups.....	27
Cohorts.....	28

Blended Learning 29

Social Network Theory 30

Summary 31

Methodology 31

 Introduction 31

 Research Questions 32

 Research Process 33

 Coding 34

 Actors 36

 Summary 37

Data Analysis 37

Discussion 44

 Outcome of Bliden Hypothesis 60

Limitations 63

Recommendation for Further Research 64

References 67

Appendix A 74

Appendix B 76

Appendix C 80

Tables and Figures

Figure 1. Adapted from Kegan's Order of Consciousness (1982, p. 109)	27
Figure 2. Example visualization for Cohort One, week one.....	42
Figure 3. Diameter chart of all three cohorts and all eight weeks.	45
Figure 4. Average degree chart of all three cohorts and all eight weeks.	46
Figure 5. Density chart of all three cohorts and all eight weeks.....	47
Figure 6. Diameter of all three cohorts	59
Figure 7. Average degree of all three cohorts.....	61
Figure 8. Density of all three cohorts.....	63
Figure 9: Adapted from Kegan's Order of Consciousness (1982, p. 109)	67
Figure 10. Density of all three cohorts.....	68
Table 1. Coded weeks per quarter.....	38
Table 2. Example chart of coded responses.....	39
Table 3. Example chart of coded translation for software.	41
Table 4. Key actors for Cohort One, week one.....	43
Table 5. Calculations for Cohort One, week one.....	43
Table 6. Centrality and distance for Cohort One.	52
Table 7. Centrality and distance of Cohort Two.....	53
Table 8. Centrality and distance for Cohort Three.	53
Table 9. Arcs for all three cohorts and all eight weeks.....	55
Table 10. In-degree and out-degree of Cohort One.	57
Table 11. Out-degree of facilitators of all three cohorts.....	64

Table 12. In-degree of facilitators of all three cohorts..... 65

Table 13. Quarters and modules of instruction for all three cohort..... 69

Introduction

Background

The idea of transforming education has been around for several decades. Many believe that transformation begins with school leaders. Philosophers, in the area of leadership, pose theories of transformation including transformational leadership and even transformation learning. The significance of transformation is to change and progressively move an organization or a person from one way of understanding, to a better more effective and positive way of functioning. The idea of transformation is to change, hopefully for the better.

Educational leaders are appointed to further the education and academic achievement of students attending their school. Transformational leadership is a progression of change and transformation of people. Transformational leaders are concerned with their follower's emotions, values, ethics, standards, and long-term goals. Transformational leadership intends to improve the motivation, morale and performance of their followers. Bass (1985) contended that transformational leadership motivates followers to do more than anticipated by: "elevating followers' levels of consciousness about the importance and value of specific and idealized goals, getting followers to transcend their own self-interest for the benefit of the organization, and moving followers to address higher level needs" (Bass, 1985, p. 20). Northouse (2013) suggests that "both charisma and emotional facets are necessary for a leader to be transformational but these elements alone are not sufficient. Transformation leaders also need idealized influence, inspirational motivation, intellectual stimulation, and individual consideration" (Northouse, 2013, p. 190-191).

The concept of making meaning is based on one's own experiences and belief system and is essential to the concept of transformational learning.

Transformational learning refers to the process by which we transform our taken-for-granted frame of reference (meaning perspective, habits of mind, mind-set) to make them more inclusive, discriminating, open, emotionally capable of change, and reflective so that they may generate beliefs and opinions that will prove more true or justified to guide actions. Transformational learning involves participation in constructive discourse to use the experience of others to assess reasons justifying these assumptions, and making an action decision based on the resulting insights (Mezirow, 2000, p. 7).

Mezirow (2000) further espouses that transformational learning is the "expansion of consciousness within the human system, thus the collective as well as the individual" (Mezirow, 2000, p. 233). For the expansion of consciousness, scholars address two: the content of consciousness and the structure of consciousness. The premise of the transformation of content of consciousness is that it forms the "content of a person's frames of reference, meaning schemes, or meaning perspective" (Mezirow, 2000, p. 231) which have four transformational learning opportunities "(1) elaborating existing frames of reference, (2) learning from new frames of reference, (3) transforming frames of reference or point of view, or (4) transforming habits of mind" (Mezirow, 2000, p. 231).

The foundation of the transformation of structures of consciousness is that consciousness evolves through successive orders or structures. Specifically, as the environment around an individual becomes more complex, consciousness changes and becomes more complex (Kegan, 1982). Kegan suggest there are 6 orders of consciousness that individual learning must advance

through in their transformational learning: incorporative, impulsive, imperial, interpersonal, institutional, interindividual. These orders of consciousness are in hierarchical order from those individuals who are most dependent on opinions of others (incorporative) to the individuals who are most reliant on developing one's own opinion (interindividual).

Purpose of the Study

The purpose of the research was to further explore graduate level blended learning cohorts at a private western university through the social networking analysis (SNA). The determination of this research is to investigate how three cohorts are shaped and affected by the structure of the blended learning program. This study examined how the relationships and interactions among individuals shapes and affect the overall cohort and to explore the evolution of each cohort over time. It was also important to investigate facilitator interactions within the blended learning program and how their contribution shapes and affects the network.

It was the intention of this investigation to add to the body of research on the constructive-developmental theory and the blended learning model by utilizing SNA to study the interactions and relations between individuals and facilitator. Contributing to the research literature is also an important aspect of this research.

The utilization of technology in blended and online learning programs is one of the fastest growing evolutions in education. It was during the 2006–2007 academic year that 61% of higher education institutions in the United States offered online courses (Parsad & Lewis, 2008). In 2002 a private university located in the western part of the United States, began a blended learning program. Although the university's traditional programs were highly successful and highly rated by the program participants in their end of course program evaluations, the program

also desired to drive the “educational experience forward through the effective use of advanced technologies” (Korach & Agans, 2011, p. 216).

Ways of Knowing

Transformational learning is the basis for the Ways of Knowing which is based in constructive-developmental theory. Ways of Knowing is an extension of Kegan’s orders of consciousness terminology which was altered by Drago-Severson. It is important to understand that transformational learning is about how one comprehends what they know and not necessarily the information that they know. The way adults process information and experiences is different based on their way of knowing. “When a person’s way of knowing changes, the person comprehends information in a different way and has enhanced his or her capacities (cognitive, interpersonal, and intrapersonal) to manage the complexities of work and life” (Drago-Severson, 2004, p. 19). Kegan (2000) states that learning which promotes skills or knowledge establishes new cognitive resources, or deepens the resources available within one’s existing way of knowing.

Drago-Severson (2012) employs Kegan’s order of consciousness, altering the terms of the final four orders of consciousness and defines them as ways of knowing. Drago-Severson (2009) describes adult ways of knowing as instrumental, socializing, self-authoring, and self-transforming. The ways of knowing terms and definition described by Drago-Severson (2009) will be used throughout the remainder of this research and are defined both in the definition of terms and in the literature review.

Blended Learning

Many higher education institutions are now considering courses that utilize both online and face-to-face methodologies to facilitate learning. There are a number of advantages in blended learning courses. Faculty, students, and administrators of higher education institutions see these courses as offering the best of both instructional worlds. Within the context of blended learning courses, the definition is a combination of online and face-to-face learning. “Programs are beginning to see the usefulness of the utilization of blended learning, particularly when they serve students whose lifestyles preclude them from attending full face-to face courses. Through utilizing blended learning, accreditations and high standards can be maintained while providing additional flexibility that students require” (Dziuban, Moskel, & Hartman, 2004, p. 5). The question is, can transformational learning occur within the blended learning environment?

Relationships and Interactions

One of the essential elements established, expressed and should be put into practice in professional learning environments such as blended learning is to establish relationships through care, respect, trust, and collaboration. Establishing relationships is important in fostering transformation. Relationship building is created by human interactions and connections through “storytelling, listening, use of language, and seeing through developmental lens which concerns...attending to the individual” (Drago-Severson, 2012, p. 99). In addition, building relationships with individuals is the core of effectively supporting growth in any teaching, learning, and professional development environment. “Building relationships requires intentional effort and purposeful interactions” (Drego-Severson, 2012, p. 117).

Social Network Analysis

Social Network Analysis (SNA) considers the dynamics and interactions among participants in a learning group. Therefore, this type of analysis can be valuable in programs focused on collaborative and communicative skills, including blended learning programs. When applied to these types of programs SNA can provide information about instructional practices which would likely facilitate participant interaction and collaboration across populations.

The significance of this study was to investigate a blended learning environment through SNA at this private university with the goal of contributing to the research literature and to the university's blended learning program.

Bliden Hypothesis of Social Network Analysis and Ways of Knowing

The hypothesis of the social network analysis is one that outlines how the structure of the network might take shape when applying Drago-Severson's ways of knowing to a cohort of people rather than individual actors. The hypothesis for the additional three ways of knowing are listed below.

- **Instrumental:** If the density of the network has the lowest percentage (0% to 10%) of actors being connected to each other; the facilitator would have and hold centrality; directionality would be towards the facilitator who holds centrality in order to accomplish the expected outcome by the facilitator however, all ties would be to and from the facilitator; then the inference is that the cohort's way of knowing is Instrumental.
- **Socializing:** If the density of the network has a lower percentage (10% to 20%) of actors being connected to each other; few actors (maybe facilitator) having centrality;

directionality would be towards centralized persons to seek approval however, the ties would be minimal; then the inference is that the cohort's way of knowing is Socializing.

- **Self-Authoring:** If the density of the network has average percentage (20% to 40%) of actors being connected to each other; the network has centrality with an average number of ties and minimal reciprocity; then the inference is that the cohort's way of knowing is Self-Authoring.
- **Self-Transforming:** If the density of the network has a high percentage (40% to 60%) of actors being connected to each other; if the network is tighter with shared centrality and a high number of ties with high reciprocity; then the inference is that the cohort's way of know is Self-Transforming.

Statement of Justification

Currently, SNA in educational research is uncommon as it relates to cohorts and their interaction and development. The justification is that the full potential of SNA as it relates to three cohorts in a blended learning program was previously undetermined and unexplored. Carolan (2014) states that SNA is the missing piece in educational research in studying relations. By conducting this research, the possible information gathered would expectantly contribute to the university, the blended learning program, and the research literature.

Research Questions

1. How does the social network of learners shape and affect the cohorts in a blended learning program?
2. How do the blended learning cohorts evolve over time?
3. How do facilitator interactions in a blended learning program influence the shape and affect of the network?

Definitions of Terms

Actors: A distinct individual that has a relationship with other entities which make up the system, also called ‘nodes’ (Borgatti, Everett, & Johnson, 2013).

Arcs: “Arcs represent those relations that are directed from one student to another” (Carolan, 2014, p. 46).

Betweenness/Bridges: “captures how actors control or mediate the relations between pairs of actors that are not directly connected” (Carolan, 2014, p.157). This research will use the terminology bridges.

Blended Learning: A formal education program in which students learn partially through online delivery of content and instruction with some element of student control over time place, path, and/or pace and partially through a facilitated face to face instruction away from home in a brick and mortar location (Watson et al, 2012; Means et al, 2013).

Centrality: “The property of the actor’s position in a network or the extent to which an actor establishes a central position in the network by having the most the number of ties. Highly central individuals are often considered ‘super hubs’; these actors are able to send and receive information to large segments of the network, thus potentially making the network more effective and efficient – or narrowing the range of relational resources available” (Borgatti, Everett, & Johnson, 2013; Daly 2010; Kilduff & Tsai, 2009).

Closeness: “captures the average distance an actors is from all other actors in the network” (Carolan, 2014, p. 156).

Cohorts: A specific design of learning community used in higher education which consist of a group of students who begin a program of study together in pursuit of a completion of a degree. These group of students proceed together through the series of developmental experiences in the context of the program of study; including sequence of classes, faculty members, and instructional activities, and end the program at approximately the same time (Maher, 2005; McCarthy at al, 2005).

Degree of Centrality: The number of ties or connections that an actor has in a network. The two methods in which degree of centrality is delineated is: *in-degree* (e.g. the number of individuals who ask the actor for advice) and *out-degree* (e.g. the number of individuals who the actor gives advice to) (Borgatti, Everett, & Johnson, 2013; Kilduff & Tsai, 2009).

Density: The number of ties in the network expressed as a proportion of the number possible. Or in other words, the number of ties in the network divided by the maximum number of ties that are possible. If all actors are isolates, density = 0; if all actors are connected to all other actors, density = 1. (Borgatti, Everett, & Johnson, 2013; Kilduff & Tsai, 2009).

Directional relation: It is the relational tie between a pair of actors that has both an origin and a destination. The tie is directed one actor in the pair to the other actor in the pair. *Non-directional relation* is when the tie between actors does not have a direction (Wasserman & Faust, 1994).

Eccentricity: “a measure of how far an actor is from the furthest other” (Hanneman & Riddle, 2005, Geodesic Distance, Eccentricity, and Diameter, para. 16).

Groups: “a number of individuals assembled together or having some unifying relationship” (*Merriam-Webster*. (n.d.). Retrieved August 2, 2013, from <http://www.merriam-webster.com/>).

Flows: “Are the outcomes of interactions, and interactions form the medium that enables things to flow. Flows may be intangible, such as beliefs, attitudes, norms and so on, that are passed from person to person” (Borgatti, Everett, & Johnson, 2013; Carolan, 2014).

Holding Environment: An environment which supports or ‘holds’ a person where he or she is in the evolution of their life experiences and the meaning he or she is making for themselves. This environment offers appropriate forms of support for one’s challenges as her or she develops without conveying an urgent need for change. The *holding environment* context provides great support and challenges in three functional areas (1) “meeting a person at his or her developmental level”; (2) challenging adults, in a developmental sense (i.e. stretching by offering alternative perspectives) to grow beyond their current level”; (3) “providing continuity and stability” (Kegan, 1994; Drago-Severson, 2009, p.310).

In-degree is the “measurement of the actors receiving the information or ties. Actors that receive information from many sources may be prestigious. Actors that receive information from many sources may also be more powerful – to the extent that knowledge is power. Actors that receive a lot of information could also suffer from information overload or noise and interference due to contradictory messages from different sources” (Hanneman & Riddle, 2005).

Isolated actors (isolates): Actors who did not collaborate with anyone else and were not acknowledged as collaborators by other actors. They do not have the juncture to provide any additional resources to the system and therefore it is difficult to influence others with their

knowledge to better support the goals of the larger organization. These actors may be professionally disconnected and require differentiated levels of support to reconnect them to the larger system (Daly, 2010)

Interactions: Transactions or activities that occur between one actor and another (e.g. who people talk to, watch movies with, hang out with, or communicate with) (Borgatti, Everett, & Johnson, 2013; Carolan, 2014).

Network: A group of actors who are connected to one another through a set of different relations or ties. A number of attributes such as: communication, knowledge, innovation or any number of resources can flow through channels between actors (Daly, 2010).

Out-degree is the measurement of actors that send out information or ties. It is the sum of the connections from an actor to others. Out-degree “usually measure how influential an actor may be” within a network (Hanneman & Riddle, 2005).

Reciprocity: A balance theory principle concerning the expectation that if A has a tie with B, that tie will be reciprocated by B. The extent of reciprocity in the network can be assessed as the number of reciprocated ties divided by the number of dyads (Borgatti, Everett, & Johnson, 2013; Kilduff & Tsai, 2009). Networks with high reciprocity may be more equal, while networks with lower reciprocity may be more hierarchical (Carolan, 2014). The higher the reciprocity in a network, the more dyadic (one-on-one) relationships are mutual (Moolenaar & Slegers, 2010).

Relational Event: relationships between actors that is not continuously persistent and is defined by a discrete event such as selling a house. *Relational States* are defined as continuously persistent such as a parent or sibling. Relational events distinguish between two interactions:

Interactions (behaviors with respect to others and often observable by a third party) and flows (outcomes of interactions, and interactions from the medium that enables things to flow) (Borgatti, Everett, & Johnson, 2013).

Self-Authorizing knower: Is a system of meaning making. A person who is in the *Self-Authoring* way of knowing “have the capacity to take responsibility for internal authoring. They can hold, prioritize, and reflect on different perspectives. Individuals with the way of knowing can access the expectations of others by their own internally generated system of values and ideology.”(Drago-Severson, 2009, p. 311) *Self-Authoring* is also known as *Institutional* in Kegan’s terminology and is an Independence stage in life (Drago-Severson, 2009; Kegan 1994).

Self-Transformation knower: Is a system of meaning making. A person who is in the *Self-Transforming* way of knowing “have the developmental capacity to take the perspective on their own authorship, identity, and ideology, forming a meta- awareness” (Drago-Severson, 2009. P. 311). A person’s self-system is available to themselves for contemplation and continuous judgment; there is an appreciation for and constant questioning of how one’s self-system works. *Self-transforming* knowers are able to understand and manage tremendous amounts of complexity. Individuals with the *self-transforming* way of knowing are less invested in their own identities and more open to other’s viewpoints. *Self-Transforming* is also known as *Interindividual* in Kegan’s terminology and is an Inclusion stage in life (Drago-Severson, 2009; Kegan 1994).

Socializing knower: Is a system of meaning making. A person who is in the *Socializing* way of knowing “have an enhanced capacity for reflection and abstract thought (i.e. thinking about thinking). They can make generalizations from one context to another and have the capacity to reflect on their actions and the action of others.” Individuals with the *Socializing* way

of knowing internalize in their psychological states and cannot take on a perspective or take on societal expectation. Approval and acceptance from authorities, and other they view as valued members of their world, is ultimate for them to internalize. *Socializing* is also known as *Interpersonal* in Kegan's terminology and is an Inclusion stage in life (Drago-Severson, 2009; Kegan 1994).

Social network: A set of actors and the relations (e.g. friendship, communication, or advice) that connect them (Kilduff & Tsai, 2009).

Social structure: The configuration of interactions that occur among the actors in a social system (Kilduff & Tsai, 2009).

Sociogram: A picture in which actors are represented as points and relationships among actors, represented lines in two-dimensional space (Kilduff & Tsai, 2009).

Strength of tie: Those social relationships that are frequent, long-lasting, and affect-laden, whereas weak ties are infrequent and distant (Kilduff & Tsai, 2009).

Transformational Learning: is the development of increased cognition, emotional, interpersonal, and intrapersonal capacities that allows a person to accomplish the complexities of work (e.g. leadership, teaching, learning, adaptive challenges) and life. The experience of transformational learning and growth create a qualitative shift in how a person interprets, organizes, understands, and makes sense of his or her experiences. This develops increased capacities for better management of the complexities of daily life. (Drago-Severson, 2009).

Transformational Leadership: actively seeks to improve the performance of followers and developing their followers to their fullest potential. "People who exhibit transformational leadership often have a strong set of internal values and ideals, and they are effective at

motivating followers to act in ways that support the greater good rather than their own self-interests” (Northouse, 2013, p. 191).

Ties: Relationship between actors (Borgatti, Everett, & Johnson, 2013).

Visualization: is a picture or diagram of the network which consists of a set of points representing actors and sets of lines representing ties. “Various characteristics of the points and lines, such as color, size, and shape, can be used to communicate information about the actors and the relationships among them. Seeing a network can provide qualitative understanding that is hard to obtain quantitatively” (Borgatti et. al., 2013, p. 100).

Ways of Knowing: is the meaning system through which all experiences are filtered and comprehended. It is also known as the developmental level, an order of consciousness, or a stage (Kegan 1982, 1994). “It is the filter through which we interpret our experiences, and it influences our capacities for perspective taking on self and other and the relationship between the two. It dictates how learning, teaching, leadership experience (and all life experiences) are taken in, managed, understood, and used” (Drago-Severson, 2009, 2012).

Whole network: The complete set of ties among all actors in a network (as opposed to the egocentric network, which is the set of ties surrounding and including one actor in the network (Kilduff & Tsai, 2009). The study of a set of ties among all pairs of actors in a given set (Borgatti, Everett, & Johnson, 2013). Whole network studies also known as complete network studies “measure the relation among actors in some bounded social group by collecting data on one or more relations among the groups of actors” (Carolan, 2014, p.68)

Literature Review

Social Constructivism

Constructivism has been debated by many philosophers and theorist over the last century. Theorist such as Piaget, Dewey, Von Glasersfeld, and Vygotsky have all contributed to the field of cognitive learning and constructivism. In the article entitled ‘the Good, the Bad, and the Ugly: The Many Faces of Constructivism’, Phillips (1995) states “there are so many versions of constructivism, with important overlaps but also with major differences, it is difficult to see the forest for the trees” (Phillips, 1996, p. 7). The fundamental theory of constructivism is that “learners are encouraged to construct their own knowledge instead of copying it from an authority, be it a book or a teacher, in realistic situations instead of decontextualized, formal situations such as propagated in traditional textbooks, and together with others instead of on their own” (Kanselaar, 2002, p. 1); in addition, new knowledge is created by the learner upon the foundation of pervious learning. Kanselaar further espouses that the new learning theory on constructivism, since 1985, have involved three aspect, not just one. The three aspects of constructivism which Kanselaar promotes is:

- a. a set of epistemological belief (belief about the nature of reality, whether there is a self-determining reality). (Von Glasersfeld, 2001);
- b. a set of psychological beliefs about learning and cognition (e.g. that learning involves constructing one’s own knowledge) (Kanselaar, 2002);
- c. a set of educational beliefs about pedagogy, the best way to support learning (e.g. that one should allow the learner to define their own learning objectives; that knowledge emerges from constructive interaction between the teacher and the student or between collaborating students) (Kanselaar, De Jong, Andriessen & Goodyear, 2000).

Although there are many, and sometimes confusing, definitions of constructivism, what stands out and it is important for this research the delineation of social constructivism. John Dewey and Lev Vygotsky are considered to be the quintessential theorist on social constructivism. Although both theorists have distinct differences in their views of society, it is the similarity of the environmental aspects of constructing knowledge and the social influences that is important for this research.

Dewey's (1963) philosophies on education emphasized "organic connections of education and experience". Dewey (1963) also articulates that "education is essentially a 'social process' and that "it is absurd to exclude the teacher from the membership of the group" as he is the "mature member" of the group who facilitates the "interactions and intercommunications which are the very life of the group and a community" (Dewey, 1963, p. 58)

Vygotsky (1997) described that the structure of the social environment is organized and manipulated by the teacher "the director of the social environment in the classroom, the governor and guide if the interaction between the educational process and the student" (Vygotsky, 1997, p. 49). From this Vygotsky established the following method for the educational development: "education is realized through the student's own experience, which is wholly determined by the environment, and the role of the teacher than reduces the directing and guiding the environment" (Vygotsky, 1997, p. 50).

Given the history and the complexity of social constructivism and the contributions of both Dewey and Vygotsky, it is apropos to say there has not just been one definition which encompasses all theories. It is essential however to define social constructivism for the purposes of this research. A simplified and concise definition is that social constructivism emphasizes the social construction of knowledge in which an "individual's interaction with a social milieu"

results in a “change in both the individual and the milieu” (Airasian & Walsh, 1997, p. 446).

This definition is comprehensive enough to include both Dewey and Vygotsky’s definitions and integrating the continuum devised by Kenselaar (2002).

Constructive-Development Theory

“Perry described intellectual development as progressing from a dualistic perspective of knowledge as right or wrong, through a multiplistic perspective in which knowledge is uncertain, to a relativistic perspective in which contextual evidence justifies knowledge claims” (Baxter-Magolda, 2010, p. 3). The basis of constructive-development is social constructivism and the evolution of intellectual development. Constructive-development theory poses that people “construct reality” and evolve through generations “according to regular principles of stability and change” (Kegan, 1982, p. 8).

Constructive-developmental theory focuses on a person as an active meaning maker with respect to cognitive, affective, interpersonal and intrapersonal (internal) experiences and how these aspects of experiences intersect. In so doing, this theory helps us to consider how to shape environments that can support development and enables us to better understand others and ourselves” (Drago-Severson, 2012, p. 22).

Figure 1 shows a mental model of an adapted version of Kegan’s orders of consciousness. It has been adapted to replace Kegan’s order of consciousness terms with Drago-Severson’s ways of knowing equivalent terms. Below figure 1 is a detailed explanation of the terms, the diagram and its relevancy.

Each order of consciousness represents a transformation between independence and inclusion (Figure 1). Individuals are able to move between orders becoming more individual and more inclusionary (Kegan, 1980). The loops in Figure 1 also represent the individual's ability to simultaneously be located in two orders of consciousness as he or she struggles to make meaning between what was subject or object. Based on research conducted by Drago-Severson (2009), individuals are only able to move between contiguous ways of knowing while advancing through the orders of consciousness.

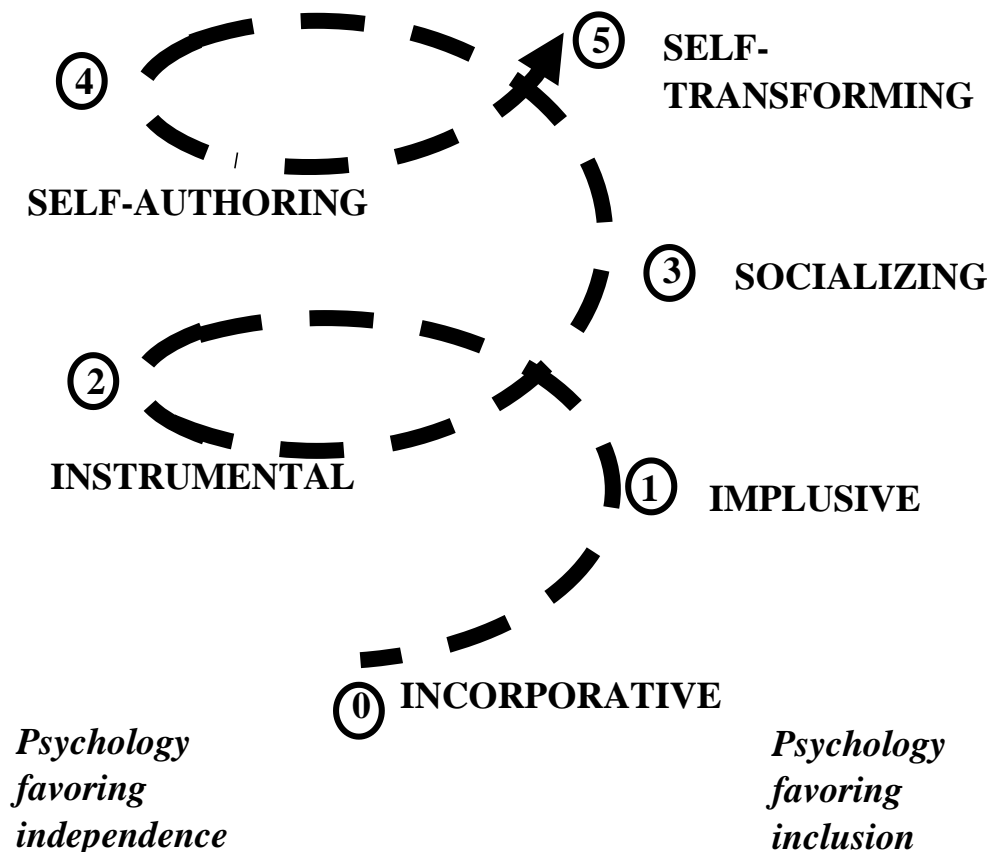


Figure 1. Adapted from Kegan's Order of Consciousness (1982, p. 109)

Incorporative/ Impulsive. These two orders of consciousness as described by Kegan (1982) are the incorporative and impulsive orders which occur during early childhood. The

proceeding four stages as defined by Drago-Severson (2012), and equivalent terms to Kegan (1982), are attained as individuals mature into adolescence and beyond.

Instrumental. “Adults who make meaning with an instrumental way of knowing...is subject to and defined by his or her own concrete needs, desires, and purposes. An instrumental knower cannot take a perspective on his or her needs, wishes, desires or interests” (Drago-Severson, 2012, p. 36). Nonetheless, the individual with an instrumental way of know does have the “capacity to control, manage, take a perspective on, and be responsible for impulses since they can be held as object” (Drago-Severson, 2012, p. 36).

Socializing. Adults who make meaning with a socializing way of knowing “have grown to develop greater internal capacities for reflection and perspective taking. Socializing knowers have developed the capacity to make generalizations from one context to another” (Drago-Severson, 2012, p. 37).

Self-Authoring. “Adults who make meaning primarily with a self-authoring way of knowing have developed the internal capacity to have a perspective on their relationships and society’s expectations. They have the capacity to hold out, consider, prioritize, and reflect on external perspectives, and decide for themselves what to do or believe” (Drago-Severson, 2012, p. 43).

Self-Transforming. “Adults with the self-transformation way of knowing have the developmental capacity to take perspective on their self-systems and identities, and can hold out their own beliefs and values for critique in order to challenge themselves to grow” (Drago-Severson, 2012, p. 44). These individuals can recognize that their own perspectives are incomplete without others’ perspectives.

Holding Environments

D. W. Winnicott in 1960 originally introduced the theory of *holding environments* which suggests that infants need a caring environment in which they are emotionally held in order for them to progressively generate healthy development. Then, after a breakthrough is accomplished, support looks and feels different to both the infant and the person creating the *holding environment*. Kegan (1982) extended the theory of the holding environment to encompass a person's entire lifespan. Kegan's theory espouses that by offering both support and challenges that are developmentally appropriate to the different ways in which people make meaning of their experiences adults will generate healthy growth.

According to Drago-Severson (2012) there are three important functions of a holding environment which can "form within a relationship, a series of relationships, an organization, a team, a family or almost any group" or cohort (p. 47).

First, it must 'hold well' by recognizing and confirming who a person is and meeting that person where he or she is (in terms of meaning making and developmental needs) without urgently pushing for change. Second,...it must 'let go' in order to challenge, stretch, or encourage that person to grow beyond his or her current meaning-making system. Third, robust holding environments must remain in place as the person grows into new ways of knowing, so that relationships can be re-formed in supportive and affirmative ways (Drago-Severson, 2012, p. 47).

Holding environments, like good teaching and learning relationships, require a keen awareness of and appreciation for individual needs and differences in order to support interactions which foster relationships and adult growth (Drago-Severson, 2012).

Groups

There is increasing acknowledgement that even adults need positive relationships between student and teacher and that relationship is important to the learning. This recognition indicates that the classroom community is vital to the transformational learning that should occur in order to create effective transformational leaders.

Cohorts

A cohort learning model in higher education is not a new concept. Although this format of learning has been inactive for a number of years, it has resurfaced in the area of school leadership (McCarthy, 2005). “In general, research conducted on cohort formats has suggested that they have the potential to fulfill students’ need for affiliation in an educational context” (Maher, 2005.p. 196). In the research conducted by Beachboard in 2011, the researchers state “our research substantiates that learning communities participation should be considered among those high-impact activities. And within the framework of learning community establishment,the fostering of academic relatedness between students and faculty” (p. 870).

The term cohort is commonly used to refer to a group of people who collectively come together for a shared purpose and then fulfill that purpose to its conclusion.

Cohorts in higher education are typically defined as a group of students who begin a program together, share the same sequence of classes, faculty members, and instructional activities toward completion of a specific degree or

certification. Recently, this definition has expanded to include the development of collaborative projects, self-directed goals, and a network of academic and social support. (McCarthy, 2005, p. 22).

More specifically, educators have attempted to establish a greater meaning of the term cohort by emphasizing the creation of shared knowledge and facilitating collaborative learning which is valued among all members.

Maher (2005) defines a cohort as: representing “one specific design of a ‘learning community’ increasingly used in both undergraduate and graduate programs. A cohort is defined as a group of about 10-25 students who begin a program of study together, proceed together through a series of development experiences in the context of that program of study, and end the program at approximately the same time” (p. 195).

Blended learning

“Blended learning is a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path and/or pace and at least in part at a supervised brick and mortar location away from home (Watson, Murin, Vashaw, Germin, and Rapp, 2012, p. 17).

Blended learning has become prevalent within numerous high education institutions because of its potential for providing more flexibility in accessing the content and instruction at any time, from any place. Reasons that learners seek out blended learning programs are many: increased availability of learning experiences for learners who cannot attend traditional face-to-face sessions as frequently; more cost-efficient instruction; and increased access to to qualified instructors in places where such instructors are not usually available. Blended learning

advocates argue further that “additional reasons for embracing this medium of instruction include current technology’s support of a degree of interactivity, social networking, collaboration, and reflection that can enhance learning relative to normal classroom conditions” (Means, Toyama, Murphy, and Baki, 2013 p. 3). A meta-analysis of research on blended learning approaches, conducted by Means (2013), found that “on average, students in online learning conditions performed modestly better than those receiving face-to-face instruction. The advantage over face-to-face classes was significant in those studies contrasting blended learning with traditional face-to-face instruction but not in those studies contrasting purely online with face-to-face conditions”. (Means et. al., 2013 p. 35)

Social Network Theory

There is a familiar proverb that states, it’s not *what* you know, it’s *who* you know that counts. This is the general idea behind social network influence and the individual’s ability to leverage professional benefit from the connection and relation to others (Dawson, 2010). Social networks are often not analyzed as pertinent to educational structures, relations, or contributing to educational success in much of education research.

An overall premise of network theory is that an actor’s position in the network determines both the opportunities and the limitations that he or she will encounter. It is for that reason that identifying an actor’s position within the network is important for predicting an actor’s outcome with regard to performance, behavior, or beliefs. Similarly, there is an equivalent hypothesis at the group level which states, what transpires with a group of actors is “a function of the structure of connections among them” (Borgatti, Everett, & Johnson, 2013, p. 1).

Social Network Analysis (SNA) provides a valuable methodology for examining the patterns of interaction that occur within a group of actors (a network). As such, SNA draws on various concepts from graph theory and structural theory to evaluate network properties such as density, centrality, connectivity, [bridges] and degrees. These measures provide a framework for interpreting and developing an understanding of the observed patterns of exchanges that occur between social actors. SNA provides a visual representation of individuals and their place in the network and provide an excellent comprehensive overview of SNA). The flexibility and value of this methodology is reflected in the quantity and diversity of studies adopting SNA techniques. (Dawson, 2010 p. 738)

Borgatti et. al. (2013) suggests there are two different classification approaches for analyzing relations within SNA, relational states and relational events. Although relational states have a valid basis within SNA through the use of studying similarities, roles and cognition of actors, it is the relational events that are of particular use because of the study of interactions and flows of the actors within the network. Interactions are observable behaviors from one person to another and “flows are the outcomes of those interactions” (Borgatti et. al., 2013, p. 4).

Summary

The theories of social constructivism and the constructive-developmental model have a direct relation to transformation learning. The constructive-developmental model contends that a holding environment is essential for progression in cognitive and social development. Furthermore, cohorts can and should act as holding environment in order to foster that development. In addition, literature on blended learning has shown that it is an effective method of delivering instruction which can promote deeper learning in individuals. Moreover, the use of

a cohort model within a blended learning program can increase individuals' opportunities for social constructivism. This in turn promotes growth and movement into new ways of knowing thus creating stronger and more connected networks.

Methodology

Introduction

Networks are a way of thinking about social systems that focus our attention on the relationships among the entities that make up the system. A generic hypothesis of network theory is that an actor's position in a network determines in part the constraints and opportunities that he or she will encounter, and therefore identifying the position is important for predicting actors outcomes such as performance, behavior or beliefs. (Borgatti et. al., 2013, p. 1).

The SNA used in this research intended to determine the shape and affect of three blended learning cohorts through interactions and flows, to analyze the evolution of the cohorts over time, and to determine if facilitator interactions assisted in contributing to the shape and affect of the each cohort. SNA was chosen with the intention that this methodology would be able to show the significance of both the structure of the group and the relations between group members. "A group of actors is in part a function of the structure of connections among them" (Borgatti et. al., 2013, p. 1).

This research was not designed to prove the effectiveness of the blended learning program as that has already been researched, wherein the findings of the research indicated that the blended learning program is in fact effective (Korach, 2011). The justification for this research was through the exploration of online threaded discussions of three completed cohorts and the analysis of those discussions using SNA which contributed to the understanding of the social network, its design, and the contribution of actors within the cohort. It was the intention for this research to contribute to both the blended learning program future cohorts and the university by conveying information that is currently unknown.

Research Questions

This social network analysis quantitative study was guided by the following research questions:

1. How does the social network of learners shape and affect the cohorts in a blended learning program?
2. How do the blended learning cohorts evolve over time?
3. How do facilitator interactions in a blended learning program influence the shape and affect of the network?

Research Process

A whole network design was utilized to structure and analyze the social network. Each of the three completed cohorts was analyzed as individual social networks as relational events based interactions and flows as well as directionality and strength of those interactions. The cohorts were then analyzed for the evolution of each cohort over time. Each cohort was in existence for one year until completion of the program. In addition, the interactions of the facilitators were also explored as to the influence each facilitator had in shaping and affecting the network. Interactions are defined as communication with other actors that constitutes a relation such as: talked to, helped, and fought with (Borgatti et. al., 2013).

The data was downloaded and collected from the archived threaded online discussion of three cohorts in a university's blended learning program. One of the cohorts had been split into two online discussion groups due to the large population size of this group. Although the group met in person as one large cohort, for the purposes of the online threaded discussions the groups

was split and treated as two separate cohorts with separate facilitators. For the purposes of this research this cohort was treated as two separate cohorts.

The names of individual actors were changes using an alphanumeric system. A number was assigned to each facilitator and student participating in the cohort. At the beginning of the number, either an F for facilitator or S for students was assigned to designate the individual's position. For example, the seventh student in the third cohort was renamed and assigned S307, and so on. Only one facilitator who was the program director participated in all three cohorts. It was decided to keep the renaming of this facilitator consistent across all three cohorts (F03, F203, F303).

Coding

The internal validity of the study was increased by researcher triangulation which utilized two researchers both collecting and analyzing the data. The codes created were based on an extensive review of the literature and supported social network validity. As for construct validity, due to the nature of the online threaded discussion being both longitudinal in nature as well as primary source for the discussion given by the actors themselves and not a report of the discussion. Validity in the case of network studies refers to the extent to which a measure actually measures what it is intended to measure (Wasserman & Faust, 1994). Detailed documentation of the data analysis was maintained throughout the process by utilizing a research log.

Two weeks per quarter were chosen for coding to represent the beginning, middle, and end of a yearlong cohort. Weeks one and two in quarter one represented the beginning of each cohort. Weeks seven and eight of quarter two along with weeks one and two of quarter three

represented the midpoint of each cohort. Weeks seven and eight of quarter four represents the endpoint of the cohort.

Table 1. Coded weeks per quarter

Q1	Q1	Q1	Q1	Q1	Q1	Q1	Q1	Q2	Q2	Q2	Q2	Q2	Q2	Q2	Q2
W1	W2	W3	W4	W5	W6	W7	W8	W1	W2	W3	W4	W5	W6	W7	W8
Q3	Q3	Q3	Q3	Q3	Q3	Q3	Q3	Q4	Q4	Q4	Q4	Q4	Q4	Q4	Q4
W1	W2	W3	W4	W5	W6	W7	W8	W1	W2	W3	W4	W5	W6	W7	W8

Interactions were coded from the online threaded discussion from these predetermined weeks. Together with a researcher who was well versed in the literature and familiar with SNA methodology, the research documented the discussion through the actor’s initial posts and their responses with included to whom the response was direct. For example, in Cohort One S07 responded to the prompt but also responded to S01, S06, and S08. Each response was coded with a 1 indicating that the actor responded once to each of the other actors. In addition, if an actor responded to the same actor more than once, then the responses were coded with a two for twice, three for three times, or four for four times. No actor responded to the same actor more than four times in a single discussion thread. The coding of the online dialogue of each cohort allowed for the examination of interactions (centrality, directionality, position, strength).

Table 2. Example chart of coded responses.

	Pmt	S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	S13	F01	F03
S01	1		1										1			1
S02	1			1		1								1		
S03	1	1						1						1		
S04	1							1	1	1				1		
S05	1	1	1				1					2	1	1		
S06	1							1				1	1			
S07	1	1					1		1							
S08	1							2					1			
S09	1				1			1			1					
S10	1				1		1	1		1				1		
S11	1	1				2			1							
S12	1									1						
S13	1								1		1					1
F01		1	1		1		1	1	1		1	1		1		
F03	1			1	1					1						

The Gephi social network analysis software (Gephi. (2014, February) *The Open Graph Viz Platform*. Retrieved from website <https://gephi.org/>) was used to create visualizations from the online threaded discussions and generated further data about social networks in order for each cohort to be analyzed. The visualizations and data were analyzed to answer Research Questions one, two, and three.

Actors

Cohort One had 12 consistent actors and two actors that dropped the program and did not participate in all four quarters and two facilitators. The data for the two actors that dropped the program were coded and included until such time as they were no longer apart of the program. Cohort Two had eight consistent actors, one actor that dropped the program and did not participate in all four quarters, and two facilitators. Cohort Three had 10 consistent actors that participated in all four quarters with two facilitators. Cohort Three did not have any actors that

dropped out of the program. It is important to note that one facilitator was mutual to all three cohorts whereas the second facilitator in each cohort was exclusive to their particular assigned cohort. The facilitator responses in the online threaded discussions were also coded. If a facilitator's response was addressing the entire cohort then the response was coded as one response to each student actor. If the facilitator additionally responded to individual actors then the response was recorded as a second or third response to that particular actor. Facilitators did not respond to each other.

Requirements were placed upon the actors to contribute to the online threaded discussions as well as the possible work habits of each individual student. The online threaded discussions are guided by prompts as well as expectations for responding. The prompts were either content related or application related prompts and were designed by the program director. The pre-constructed prompt was given to the students at the beginning of the week. One of the conditions by which people were instructed to respond was that the students had to respond to the prompt and subsequently respond to two other students by Friday of that week. In addition, facilitators were coached to respond to at least three student participants as well as any student participant with no responses from a fellow cohort students.

Summary

There were three cohorts which consisted of four quarters of online threaded discussions. Eight weeks of data were coded for each cohort consisting of two weeks per quarter. This created an overall picture of the yearlong interactions of the actors by coding the beginning, middle and end of each cohort. Actor responses were coded and documented for each pre-determined week for each cohort. The validity of the study was improved by researcher triangulation which utilized two researchers both collecting and coding the data.

Data Analysis

Table 3. Example chart of coded translation for software.

Source	Target	Type	Id	label	Weight
S201	S202	Directed			1
S201	S202	Directed			1
S202	S203	Directed			3
S202	S205	Directed			1
S203	S202	Directed			1
S203	S208	Directed			1
S204	S202	Directed			1
S204	S203	Directed			1
S204	S208	Directed			1
S205	S206	Directed			1
S205	S208	Directed			1
S206	S205	Directed			1
S206	S208	Directed			1
S207	S202	Directed			2
S207	S204	Directed			2
S207	S205	Directed			2
S207	S208	Directed			3
S208	S203	Directed			1
S208	S204	Directed			1
S208	S205	Directed			1
S208	S206	Directed			1
S208	S207	Directed			1
S214	S205	Directed			1
S214	S208	Directed			1
F203	S202	Directed			2
F203	S201	Directed			1
F203	S203	Directed			1
F203	S204	Directed			1
F203	S205	Directed			1
F203	S206	Directed			1
F203	S207	Directed			1
F203	S208	Directed			1
F203	S214	Directed			1

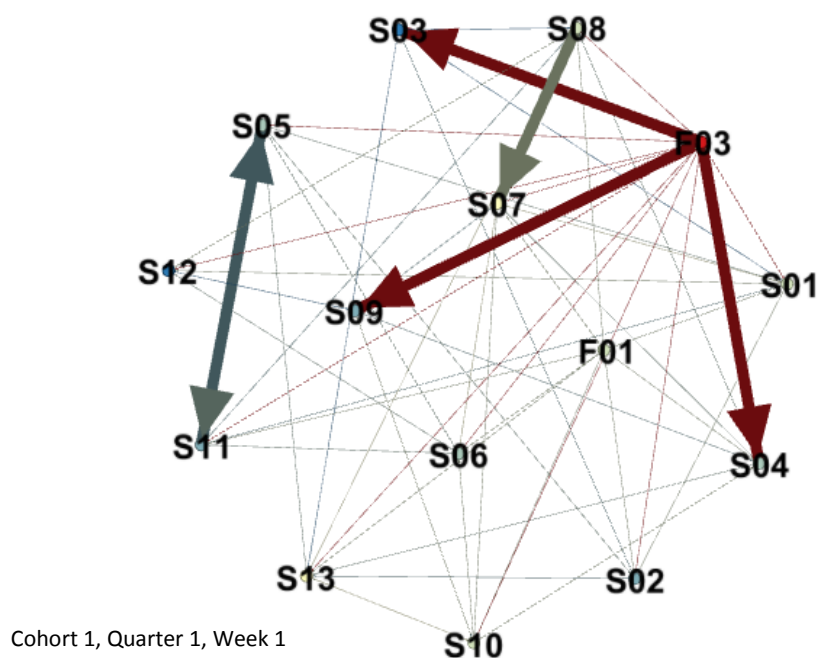
Cohort 2, Quarter1, Week 1

“One of the most important steps in any network analysis is formatting the data for import into a network analysis software package” (Borgatti et. al., 2013, p. 62). It is important

to obtain the data and then eventually house it in an electronic file. In coding the eight weeks of online threaded discussion responses in collaboration with another researcher, the data was transferred in an Excel spreadsheet as it appears in table 2 above. Once all eight weeks were completed and housed electronically, this researcher then translated the coding into another Excel spreadsheet (table 3) suitable for importing into the Gephi software. Once the data was translated into a compatible Excel spreadsheet, it was then saved as a CSV file so that Gephi could read the spreadsheet. Gephi 0.8.2 beta is an open source software and was used to analyze this research. The Gephi software can be located at gephi.org.

Once the CSV file was imported into Gephi a visualization of the interactions for that particular week were then created and analyzed. The program was used to run calculations on Diameter, Density, Degree (literal number of connections between actors), Bridges, Eccentricity (maximum distance between a single actor and another actor in the network), Closeness (typical distance between all actors), In-Degree (how many responses are directed to the actor), and Out-Degree (how many responses originate from the actor). The layout that was chosen for the

Figure 2. Example visualization for Cohort One, week one.



visualization was Fruchterman Reingold because of the clarity of direction of interactions among the actors as well as the ability of the researcher to assess the degree metric. This process was completed for each of the eight weeks per cohort which were chosen for coding. Below is an example of one week of visualization for Cohort One in figure 3. All visualizations, charts and calculations for the three cohorts can be found in Appendix C.

Table 4. Key actors for Cohort One, week one.

	Centrality	Bridges	Eccentricity	Closeness	In-Degree	Out Degree
Cohort 1 Wk 1	F03	F03	S12	S12	S01	F03

Table 5. Calculations for Cohort One, week one.

Node	Centrality	Eccentricity	Closeness	Bridges	Strongly-Connected ID	In-Degree	Out-Degree
S01	9	2	1.76	31.55	0	6	3
S02	7	3	2.07	8.85	0	4	3
S03	5	3	2.15	1.53	0	2	3
S04	8	3	2.00	4.78	0	4	4
S05	8	3	1.76	7.90	0	3	5
S06	8	4	2.30	11.71	0	5	3
S07	10	3	2.23	25.08	0	7	3
S08	9	4	2.69	7.66	0	7	2
S09	7	4	2.38	17.00	0	4	3
S10	9	3	1.84	10.13	0	4	5
S11	7	3	2.07	7.60	0	4	3
S12	5	5	3.15	9.21	0	4	1
S13	10	2	1.76	24.23	0	7	3
F01	9	2	1.35	0.00	1	0	9
F03	15	1	1.00	35.73	0	2	13

Cohort 1, Quarter 1, Week 1

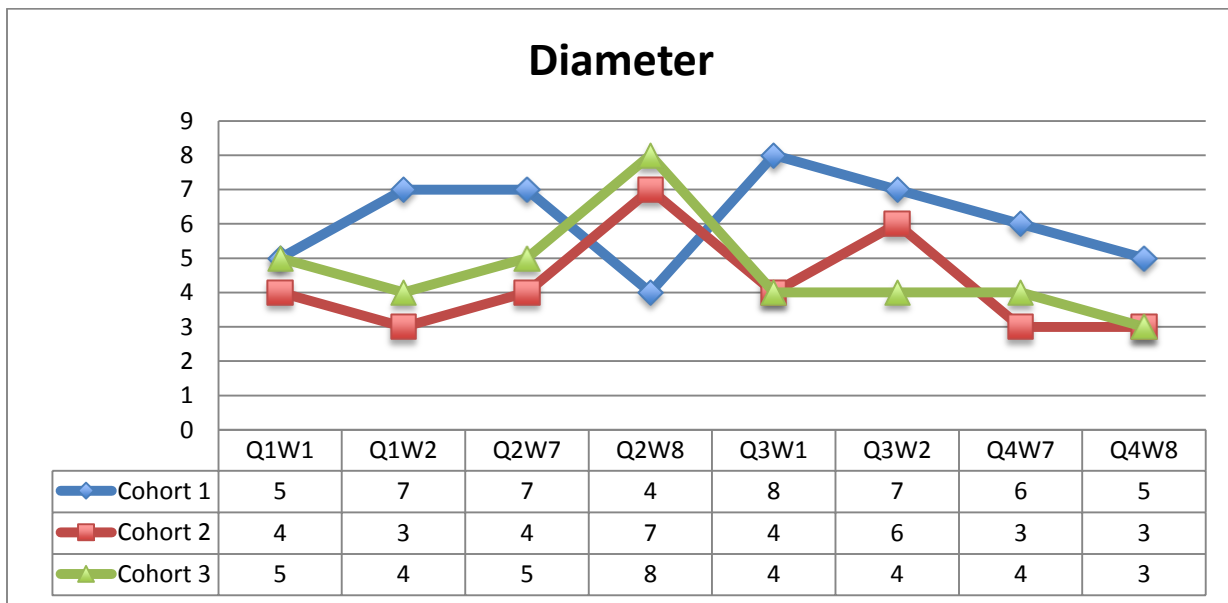
Centrality is the property of the actor's position in a network or the extent to which an actor establishes a central position (Borgatti, et. al., 2013). Distance is the number of moves it takes for one actor to move information to an unconnected actor on the same network. The distance will be determined by the direction in which one actor interacts with another actor and then counting the moves to an unconnected actor. Once distance is established then an examination of whether the network is spread-out or close will be determined. An average number of moves will create a midpoint and then from there the furthest point and the closest point can be determined (e.g. eight moves might appear to be spread out where four moves or less would be close).

In the above visualization in Figure 2 of Cohort One, quarter one, week one, actor F03 had centrality with a degree of 15 connections between themselves and other actors. In addition, F03 also had the highest level of bridges with 35.73 connections. S12 had the highest eccentricity score of 5.0 meaning that this actor had the furthest distance to another single actor. It would take S12 five steps or connections to get information to another single actor. The Diameter of Cohort One, week one, was five which means no actor could be further apart in distance from another actor than 5.0. The diameter is the largest distance in a connected network. S12 also had Closeness with 3.15 that they were also the furthest in distance from all other actors. S01 has the highest level of In-Degree at six meaning they had the highest number of responses directed to them. F03 had the highest level of Out-Degree at 13 meaning they had the highest level of responses originating from them to other actors.

In analyzing the diameter (figure 3) and the average degree (figure 4) the yearlong time frame for all three cohorts, there were a few noticeable changes. The fluctuation of a diameter of a network would indicate a change in the structure of the cohort. For instance, if a diameter were

to increase, it may be due to an actor no longer responding or being removed from the network altogether. If a network were to decrease the diameter, it may indicate that an actor increased their positive influence, that an actor decreased a negative influence, or that an influential actor moved into the network. As for the diameter of these three cohorts, they started their year with a relatively small diameter, increased and decreased the diameter during the year and then ended with either the same size or a smaller diameter as in the beginning. In week eight of quarter two cohorts two and three increased their diameter whereas Cohort One decreased the diameter.

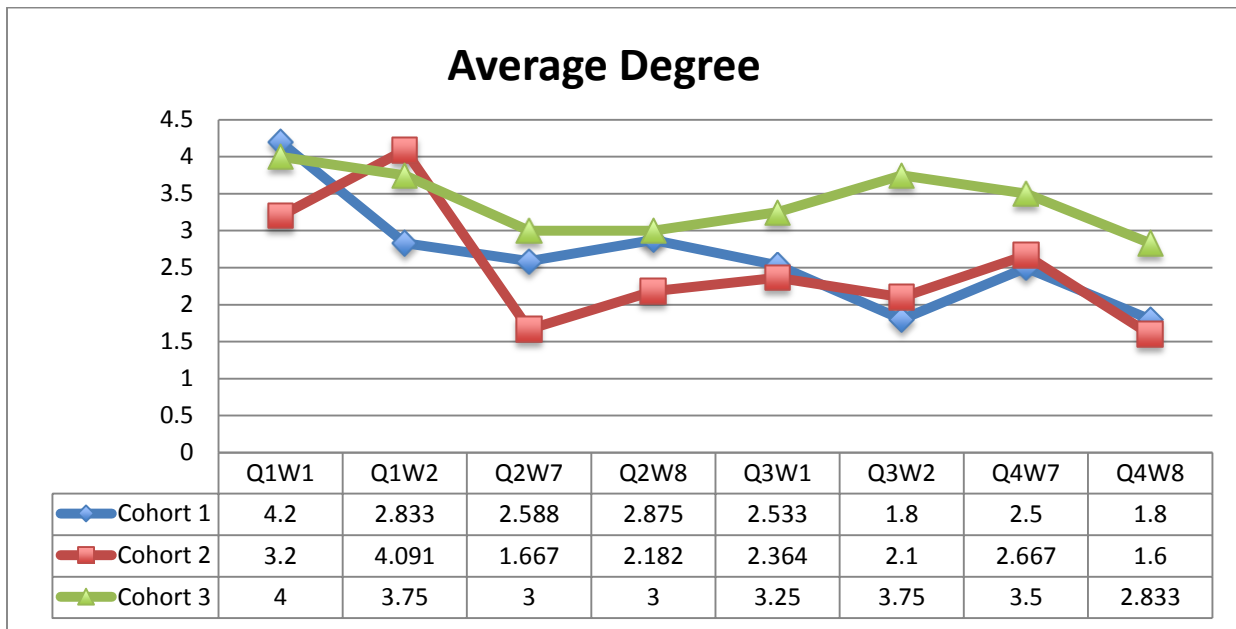
Figure 3. Diameter chart of all three cohorts and all eight weeks.



The average degree of a network is the average number of connection among the actors across the network. This is calculated by taking the total weight of the arcs and dividing it by the number of actors which gives the average degree. For example: In Cohort One, week one, there are 63 arcs divided by 15 actors which equals 4.2. This means Cohort One, week one, has an average of 4.2 connections. In table 8 below, it shows that the average number of connections across each cohort varied throughout the year. Cohort One started with a higher number of average connections and gradually decreased throughout the yearlong program. Cohort Two had

a dramatic increase and then a dramatic decrease at the beginning, finally leveling off for the remainder of the year. Cohort Three, although they had some minor fluctuations in the average number of connections, was relatively constant. The final quarter of each cohort may have resulted in less responses thereby lowering the number of average connections if actors were feeling anxious about finishing the program.

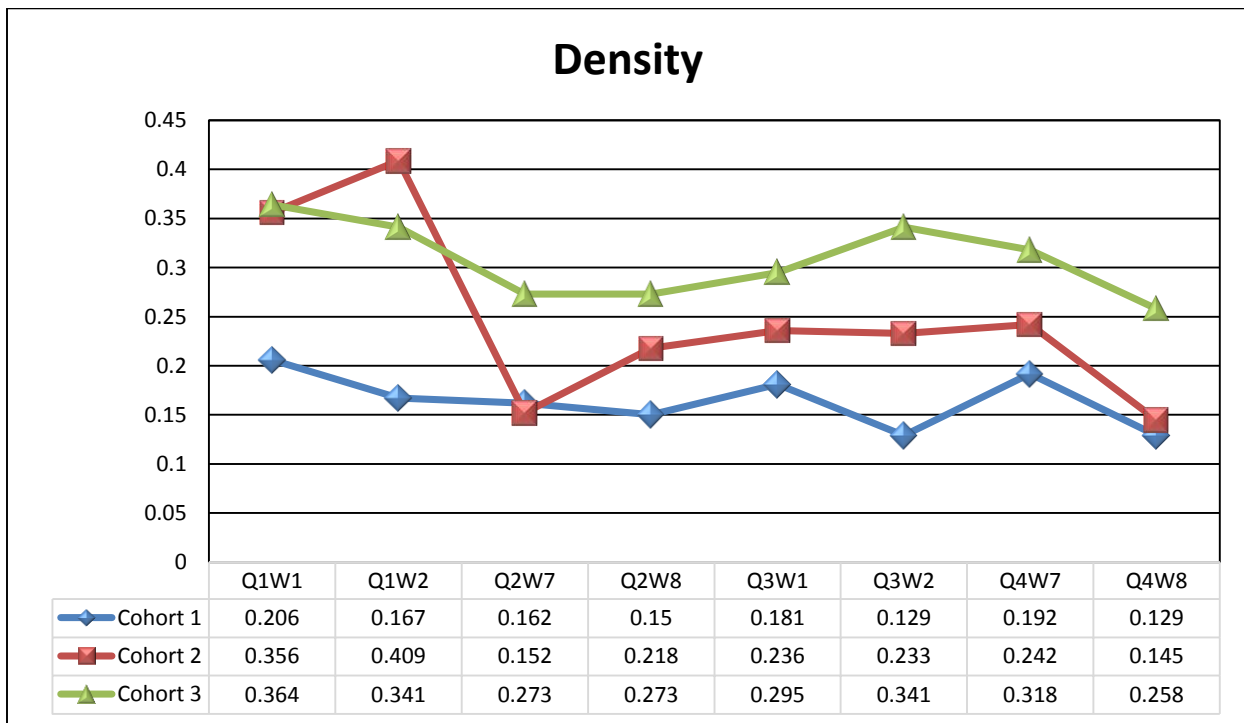
Figure 4. Average degree chart of all three cohorts and all eight weeks.



Density is simply the number of connections in the network expressed as a proportion of the number possible. The value of 1 is a completely connected network of actors with all actors connected to one another. A null network was created to indicate the density of a random network for comparison. The null network consisting of 10 student actors and 2 facilitators. These were the average number of actors participating between the three cohorts. Interaction were randomly assigned to every seventh cell on the Excel spreadsheet both vertically and horizontally. Additionally, each student actor in the null network responded to the prompt. The results show that the density of the null network was .205 or 20.5%.

If the number .206 is calculated in the same manner as for Cohort One, week one, then the density shows that 20.6% of the cohort is connected. Figure 5 shows that in all three cohorts, some weeks the cohort was connected more than in other weeks. The density also shows that cohorts one and three were fairly consistent in their connections whereas Cohort Two had more variance in their connections to one another. Cohort Three started the program having more connectivity than any other cohort and ended with a higher rate than any other cohort. Cohort One started with much lower connectivity and ended with low connectivity. Cohort Two started with high connectivity and ended with low connectivity.

Figure 5. Density chart of all three cohorts and all eight weeks.



Discussion

Question 1: How does the social network of learners shape and affect the cohorts in a blended learning program?

After analyzing the data for all three cohorts for the eight weeks of predetermined historical online threaded discussions, many structures and relationships become evident. These observations were helpful in determining the shape and affect of the network. Cohort Three is the only cohort that did not have an actor drop out of the cohort, maintaining all ten actors throughout the cohort. Cohort One had one actor who joined late in the program and two actors who dropped from the program, and maintained twelve actors throughout the program. Cohort Two had one actor that dropped from the program but maintained eight actors throughout the program.

In discerning both the centrality and bridges, neither the actor that obtained the highest degree of centrality nor the actor that obtained the highest bridges were consistent from week to week in any cohort. In Cohort Two there was one actor (S207) that maintained centrality for three consecutive coded weeks and in Cohort Three, there was one actor (F306) that maintained centrality for two consecutive coded weeks; however, the consecutive coded weeks were not consecutive weeks within a quarter. Therefore, if all weeks in the quarter were coded, the same actors may be found to hold the position of centrality or actors may alternate for the position. With the weeks that were coded some actors alternated weeks; therefore it is possible that, if all weeks were coded, this pattern might continue. In Cohort Three it was generally a facilitator that had centrality. There were only three weeks where a student either shared or individually held centrality. No one person in any one cohort maintained centrality throughout a year-long cohort.

The actors that alternated in the position of both centrality had greater connectivity to other actors in their cohort. (See tables 6, 7, and 8 below for actor positions.) F

It may be beneficial for facilitators in this program to identify the actor with high centrality. Once these actors are identified, facilitators could use this knowledge to give the appropriate responsibility in order to increase the positive functionality to the network or give facilitators an opportunity to restructure the cohort if the actor is of negative influence. Facilitators may want to give the small group of actors with high centrality who have positive influence the opportunity to have their own discussion boards or to lead alternative threads of discussions. If an actor has a negative influence, then this would give the facilitator the opportunity to engage in conversation with the actor.

In all three cohorts, mainly students held the bridges position. Only on three occasions, once in Cohort One (quarter 1; week 1), once in Cohort Two (quarter 3; week 1) and once in Cohort Three (quarter 4; week 8), a facilitator held the position of bridges. There were a few actors in each cohort, including the facilitators, which held either centrality or bridges which represented a smaller group within the whole network. Sometimes the same actor held both positions for a particular week. There were occasions where centrality and bridges were held by two different actors in the cohort. No one actor in any cohort maintained bridges throughout the year-long cohort; however, the person with bridges constantly had a higher centrality. The actors that held the bridges position was of great importance to the actors that were not connected to the actors with high centrality. These networks represent a highly centralized network in a majority of the weeks which were coded. Highly centralized networks are networks in which relations are focused on one or a small set of actors. The bridges actors allow the less connected actors to send and receive information to a more centralized actor thereby keeping them connected to the

whole network. It is important for facilitators to continue to notice the student actors who have not received responses from other student actors, and potentially utilize the actor with a high bridges position to connect the actors who have the high eccentricity.

It is important to know who the small group of actors are which hold the centrality and the bridges positions within a cohort. The centrality position sends and receives the most information and the bridges position transports the most information from one actor to another. These positions could be helpful in disseminating important information and foster deeper inquiry based discussions. These positions can translate to positions of influence, power, or control. These positions, used effectively, could help the cohort transition informational learning into transformational learning thereby moving actors into a higher way of knowing. See Appendix C for visualizations and calculations for the coded week for each cohort.

Observations regarding eccentricity (highest distance between an actor and any other single actor) and closeness (typical distance between all actors), which represents the distance calculations of a social network analysis, indicated that the actor with the highest eccentricity or highest closeness transitioned from actor to actor. No one actor in any cohort consistently maintained the position of highest eccentricity or throughout the year-long cohort. There were several actors in each cohort, including the facilitators, which held eccentricity or closeness centrality. Both the eccentricity and the closeness actor positions are actors who are on the outside of the network. Sometimes the same actor held both positions for a particular week. There were occasions where eccentricity and closeness were held by two or more actors which would indicate that the networks were small in size and the actors were fairly close in distance. The fact that no actor was consistently on the outskirts of the network would be representative of an effectively functioning network. One possibility is that student actors were effective in

keeping all student actors connected to the network. Another possibility could be that facilitators were effective in keeping student actors connected and so no actor would feel left out.

The group of actors that generally held high centrality or bridges and the group of actors that held high eccentricity or closeness were a smaller group. There were rare occasions when student actors that held high centrality or bridges then moved over time to high eccentricity or closeness. This movement occurred with two student actor in Cohort Two and two student actors in Cohort Three. The reverse was true on one occasion when a student actor in Cohort One started with the position of eccentricity and by the end of the program moved to a position of centrality. There was one facilitator, who was the only constant facilitator in all three cohorts (F03, F203, F303), who moved from a high centrality to a high eccentricity. Most frequently an actor who moved out of a position of centrality or eccentricity moved into a neutral position.

Actors that move from a high centrality to eccentricity could mean that the particular actor was overloaded with information either giving or receiving and withdrew from the centralized position to prevent from being overwhelmed. It is important to recognize that an overload of information is possible and to recognize when this has occurred in order for an actor to stay engaged and participating. Facilitators should look out for student actors who stop contributing to the cohort in the manner in which they are used to seeing them contribute. It is possible to stagnate an actor from creating deeper learning or to lose them from the program altogether. A movement from centrality to eccentricity may indicate stagnation or loss of interest. Actors that move from eccentricity to centrality indicate that actors can move from a position of minimal engagement to holding a position where much information is given and received and may hold a position of influence. The results of this research would indicate that it is possible to move actors from one position to another. If purposeful, facilitators could save

potentially withdrawing students or counsel out students who may not achieve at the program standard of transformational learning.

In a discussion with the program director (R. McClure personal communication, December 3, 2013) she indicated the desire of the program would be for the facilitator to start the program with much interaction and influence and then gradually remove themselves from such a position by the end of the program. In Cohort One F03 held high centrality in week one and two of quarter one (winter quarter) and then high eccentricity and closeness in week seven of quarter two (spring quarter). In Cohort Three F303 held high centrality in week eight of quarter two (fall quarter) and week seven of quarter four (spring quarter) then high eccentricity in week eight of quarter four (spring quarter). This could indicate that this facilitator may have been purposeful in withdrawing responses to student actors to allow the network to sustain and grow without significant input from facilitator. Facilitator F03, F203, F303 is the only facilitator who moved from a centrality to eccentricity.

Table 6. Centrality and distance for Cohort One.

Cohort One	Centrality	Bridges	Eccentricity	Closeness
Coht 1 Wk 1-Winter	F03	F03	S12	S12
Coht 1 Wk 2-Winter	F03	S10	S02, S05, S12	S12
Coht 1 Wk 7-Spring	S06, F02	S14	S05, S08, S09, F01, F03	F03
Coht 1 Wk 8-Spring	S10	S09	S01, S03, S08, F01, F03	S08
Coht 1 Wk 1-Summer	F03	S04, S10	S11	S11
Coht 1 Wk 2-Summer	S09, S06	S01, S02	S05	S05
Coht 1 Wk 7-Fall	S12	S12	S11	S11
Coht 1 Wk 8-Fall	S01, S06	S06, S05	S09, S11, F03	S07

Table 7. Centrality and distance of Cohort Two.

Cohort Two	Centrality	Bridges	Eccentricity	Closeness
Coht 2 Wk 1-Summer	S208	S208	S201	S201
Coht 2 Wk 2-Summer	S207	S207	S201, S204, S205	S204
Coht 2 Wk 7-Fall	S207	S207, S208	S202, S204	S206
Coht 2 Wk 8-Fall	S207	S208	S206	S206
Coht 2 Wk 1-Winter	F207	F207	S202	F203
Coht 2 Wk 2-Winter	S203, S208	S205	S207	S207
Coht 2 Wk 7-Spring	S203, S207	S203	S201, S202, S205, S206, S208, F207	S202
Coht 2 Wk 8-Spring	S203, S207	S207	S201, S204, S206, S207, S208, F203	S206, F203

Table 8. Centrality and distance for Cohort Three.

Cohort Three	Centrality	Bridges	Eccentricity	Closeness
Coht 3 Wk 1-Summer	S309	S304	S306, S301, S302, S303	S301
Coht 3 Wk 2-Summer	F306	S306	S301, S303, S305, S307	S305
Coht 3 Wk 7-Fall	F306	S303	S302	S309
Coht 3 Wk 8-Fall	F303	S301	S304	S304
Coht 3 Wk 1-Winter	F306	S303	S310	S310
Coht 3 Wk 2-Winter	S307	S304	S303, S306, S308, S310	S308
Coht 3 Wk 7-Spring	S310, F303, F306	S305	S304, S305, S308	S308
Coht 3 Wk 8-Spring	F306	F306	S302, S303, S305, S307, F303	S303, S307

In Cohort One, except in quarter four, week seven, there were strong arcs between certain actors. Often, there were weeks with multiple actors with strong ties to another actor or multiple actors. In Cohort Two, there were two weeks that were coded without strong arcs to other actors which was quarter two, week eight and quarter three, week eight. All other weeks had strong arcs to either one actor or multiple actors. In Cohort Three every coded week had an actor or multiple actors with strong ties to at least one other actor. Cohort Three is the only cohort that maintained strong arcs in every coded week. Strong arcs would indicate a strong connection or relations between certain actors. This information may be of benefit when needing to communicate a significant learning to the entire cohort or when needing to develop a deeper

inquiry based discussion. The actors with strong ties could create this environment of learning. Facilitators can foster leadership and influence in the network by strategically sharing information with actors who have strong ties thereby decreasing facilitators' out-degrees and consequently, influence. See Appendix C for visualizations and calculations for each coded week for each cohort.

Cohort One, week one, had many arcs and more arcs than any other week or any other cohort. It is unknown as to why Cohort One, week one had more arcs than any other week or any other cohort. Because Cohort One had more actors than any other cohort, the expectation might be that Cohort One had more arcs than cohorts with less actors. There is evidence that the 63 arcs in week one were not due to the number of participants in Cohort One. In later weeks in Cohort One the number of arcs dropped to relatively the same number of arcs as other cohorts and other weeks. The number of arcs each week could indicate the inquiry based prompt was engaging and therefore more discussion occurred. It is important to know the number of interactions each week in order to facilitate deeper discussions or be able to adjust learning as it occurs. Below in table 9 is a list of all the weeks in each cohort and the number of arcs or arcs they had.

Table 9. Arcs for all three cohorts and all eight weeks.

	Cohort One	Arcs	Cohort Two	Arcs	Cohort Three	Arcs
Qt 1	Coht 1 Wk 1-Winter	63	Coht 2 Wk 1-Summer	32	Coht 3 Wk 1-Summer	48
	Coht 1 Wk 2-Winter	51	Coht 2 Wk 2-Summer	45	Coht 3 Wk 2-Summer	45
Qt 2	Coht 1 Wk 7-Spring	44	Coht 2 Wk 7-Fall	20	Coht 3 Wk 7-Fall	36
	Coht 1 Wk 8-Spring	46	Coht 2 Wk 8-Fall	24	Coht 3 Wk 8-Fall	36
Qt 3	Coht 1 Wk 1-Summer	38	Coht 2 Wk 1-Winter	26	Coht 3 Wk 1-Winter	39
	Coht 1 Wk 2-Summer	27	Coht 2 Wk 2-Winter	21	Coht 3 Wk 2-Winter	45
Qt 4	Coht 1 Wk 7-Fall	35	Coht 2 Wk 7-Spring	32	Coht 3 Wk 7-Spring	42
	Coht 1 Wk 8-Fall	27	Coht 2 Wk 8-Spring	16	Coht 3 Wk 8-Spring	34

Out-degrees is the measurement of actors that send out information or arcs. It is the sum of the connections from an actor to others. For example: actor S01 sent out three pieces of information or arcs to three other actors in quarter one, week one. According to Hanneman and Riddle (2005) out-degrees “usually measure how influential an actor may be” (Basic Demographics, para. 5) within a network. In-degree is the “measurement of the actors receiving the information” (para. 9). For example: S01 received six pieces of information or arcs from six other actors. “Actors that receive information from many sources may be prestigious. Actors that receive information from many sources may also be more powerful – to the extent that knowledge is power. Actors that receive a lot of information could also suffer from information overload or noise and interference due to contradictory messages from different sources” (para. 9).

The number of pieces of information sent out or received does not always equal the number of actors sending or receiving the information. For example: S08 sent out three pieces of

information to two other actors and actor S07 received seven pieces of information from six other actors in quarter one, week one. In table 10 is the in-degree and out-degree for Cohort One. The actors highlighted in green were the student actors that most likely had the most influence for that particular coded week. The actors highlighted in yellow are the student actors that most likely had the most power and prestige. In many weeks more than one actor held the influential position (out-degree) and powerful and prestigious position (in-degree). To determine whether the in-degree actor is either in a position of power and prestige or in information overload is subject for possible further research. Understanding a student's position whether it is of influence, power and prestige, or overloaded will help a facilitator foster deeper learning and higher ways of knowing. This information would give the facilitator the knowledge about which students may be significant in sustaining an environment of deep learning while the facilitators' influence is gradually removed. This may give knowledge to develop an environment of students asserting and developing knowledge from each other. The result of the in-degrees and out-degrees of all three cohorts are in Appendix B.

Table 10. In-degree and out-degree of Cohort One.

Coht 1	Qt 1, Wk 1		Qt 1, Wk 2		Qt 2, Wk 7		Qt 2, Wk 8	
Node	In-Degree	Out-Degree	In-Degree	Out-Degree	In-Degree	Out-Degree	In-Degree	Out-Degree
S01	6	3	5	2	2	2	4	2
S02	4	3	5	3	4	3	4	3
S03	2	3	4	2	4	3	4	2
S04	4	4	4	3	2	3	3	5
S05	3	5	5	3	2	3	6	3
S06	5	3	5	2	5	3	2	3
S07	7	3	2	3	4	2	2	0
S08	7	2	3	2	4	2	4	2
S09	4	3	4	3	2	2	5	5
S10	4	5	4	4	4	2	2	4
S11	4	3	2	3	4	3	2	3
S12	4	1	4	2	3	3	3	4
S13	7	3	2	2				
S14					3	2		
	Qt 3, Wk 1		Qt 3, Wk 2		Qt 4, Wk 7		Qt 4, Wk 8	
Node	In-Degree	Out-Degree	In-Degree	Out-Degree	In-Degree	Out-Degree	In-Degree	Out-Degree
S01	4	2	2	2	3	2	4	2
S02	3	2	2	2	3	1	2	0
S03	3	2	2	3	3	2	2	2
S04	4	2	1	2	2	5	1	3
S05	2	2	2	2	5	2	3	2
S06	3	0	3	2	3	2	4	2
S07	1	0	0	0	4	2	2	1
S08	4	2	2	1	2	2	2	2
S09	2	2	4	2	2	2	2	2
S10	5	2	4	2	2	2	3	0
S11	4	2	3	1	2	1	0	2
S12	2	4	2	3	3	6	2	3

Question 2: How do the blended learning cohorts evolve over time?

In order to answer this question, the diameter, the average degree and the density of all three cohort networks were analyzed. The diameter of a network is the largest distance in a connected network. This research analyzed all three cohorts as whole networks which is an analysis that examines the whole population of the network instead of a portion of the

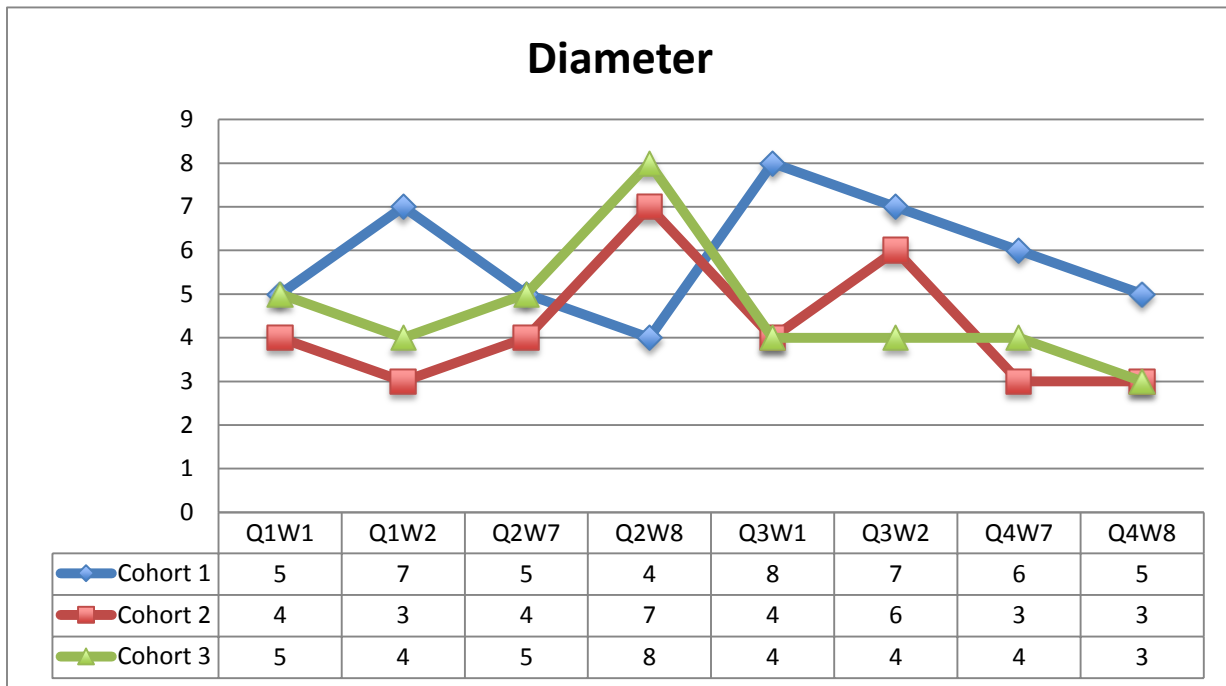
population. It was also determined that all three cohorts were connected networks which are networks where all of the actors are connected. In larger networks, some actors may not have the direct communication or connection with all actors. When analyzing these whole and connected networks, the distance among the actors are at times small and at other times a bit larger. The size of the cohorts indicate that the information distributed among the network is likely to reach everyone due to the size.

When analyzing how the diameter of the cohort has evolved over time, the results show that in two of the three cohorts, Cohorts Two and Three, decreased gradually over time from beginning to end with an increase sometime during the middle of the program. Cohort One actually ended at the same diameter in which they started. In the case of cohorts two and three, they almost mirror each other in diameter. Cohort Two starts with no actor being more than four steps away from any other actor and they ended the cohort with no actor being more than three steps away. In the middle of the program during quarter two, week eight, and quarter three, week two, the cohort's diameter reached seven and six steps before reducing again. This was the same for Cohort Three. Cohort Three started a no actor being more than five steps from another actor and ended with no actor being more than three steps. They too had an increase in quarter two, week eight, where their diameter reached eight. In Cohort One, they started with no actor being more than five steps away from another actor and ended with the diameter of five. For Cohort One however, they had an initial increase in diameter to seven with a decrease to four and then a substantial increase to eight before reducing again.

The changes in diameter among the 3 different cohorts may have been influenced by the prompt. In Cohort Three, quarter two, week eight, one possible reason for the increase in diameter may have been due to actor S305 responded only to the prompt and did not respond to

any other actor as in other weeks. In Cohort One, quarter two, week eight, the network decreased in diameter, and this may be due to actor S14 who dropped out of the network and in the previous week held the highest bridges position. This may indicate that actor S14 was contributing to the network in a negative manner. The evolution of the diameter of these cohorts is presented in figure 6 below.

Figure 6. Diameter of all three cohorts

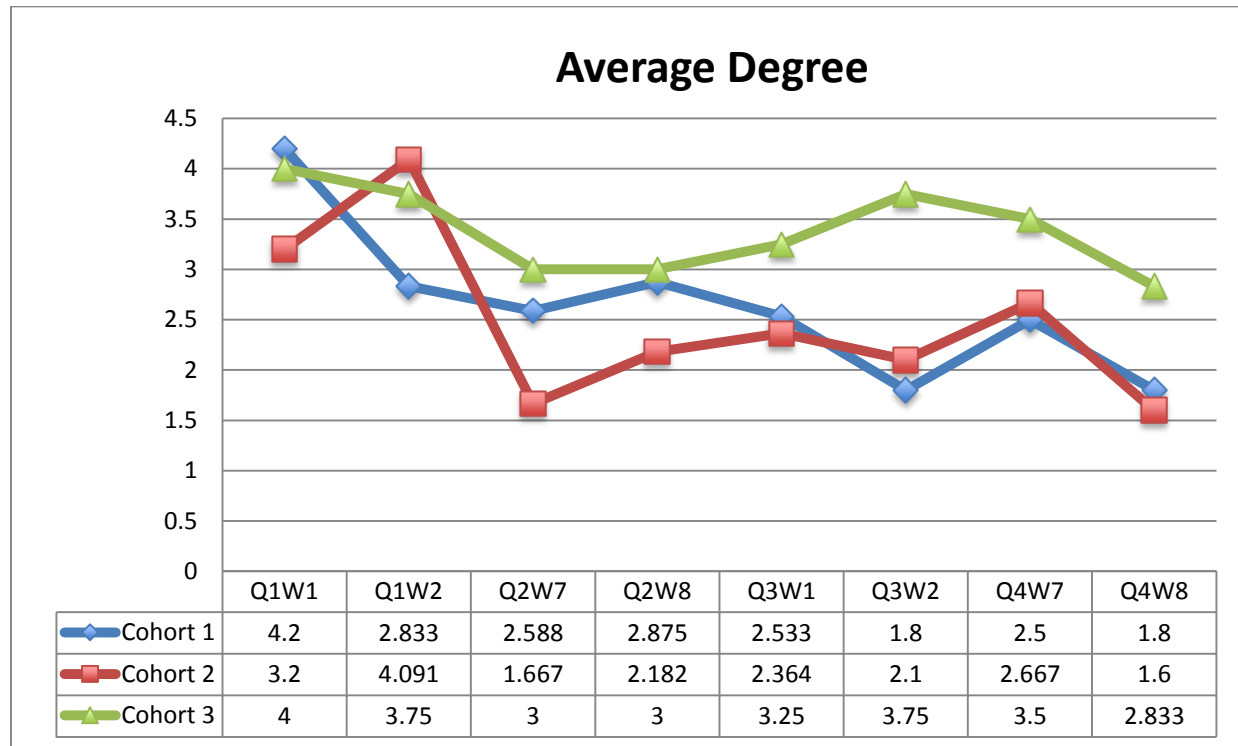


The average degree of the network is the average number of connections across the network. The average degree of all three cohorts were calculated as unweighted. This was determined during a discussion with the program director. The program director indicated that all students and facilitators were equal members of the cohort; therefore, all actors were given an equal weight of one and calculated as unweighted.

In analyzing how the average degree of the cohort has evolved over time, the results shows that all three cohorts decreased gradually over time from beginning to end. Although Cohort One gradually decreased their average degree over the year, cohorts two and three

showed an increase in average degree at some point during the year. Cohort Two had an initial increase in week two of quarter one and then a significant decrease in week seven, quarter two. This significant decrease was more substantial than any other cohort at any other time during their program. There isn't enough data to draw a conclusion as to why this cohort had a significant decrease at that particular time. The reason the average degree increased creating a higher degree of connectedness in quarter one, week two, is because in that particular week both facilitators had a significant number of responses to all cohort member. Cohort Three had a gradual decrease in average degree and then increase with the peak at quarter three, week two, before their final decrease. It is undetermined as to why there was an increase for Cohort Three during that particular week. What this means in whole is that the actors in each cohort had a higher degree of connectedness at the beginning of the program versus the end of the program. This may mean that all three cohorts were enthusiastic about being included in the cohort and at the end of the cohort, actors were settling into more of an independence position, looking forward to their next step in an independent manner. This appears to be a natural response to the program of study.

Figure 7. Average degree of all three cohorts.



Density is the average strength of arcs across all possible arcs and in a connected and directed network, such as the networks in this research, density is calculated across the total number of actors. Simply, it is the sum of the values of all arcs divided by the number of possible arcs. As stated above, if the value of 1 is a completely connected network of actors with all actors connected to one another, then a number density of .206, as for Cohort One week one, shows that 20.6% of the cohort is connected. In analyzing how the density of the cohort has evolved over time, the results show that all three cohorts decreased gradually over time from beginning to end and almost mirrors that of our average degree.

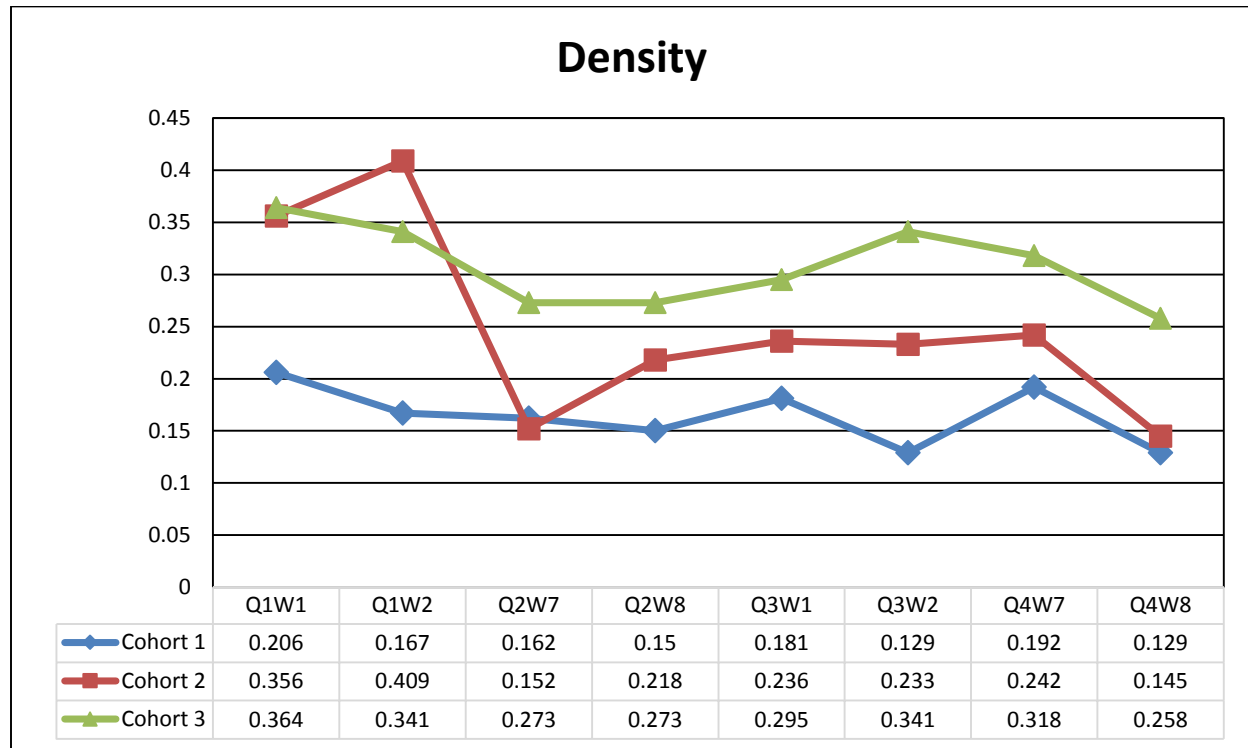
The density of the null cohort was 20.5 %. The density for Cohort One started lower and ended lower than any other cohort. They started with 20.6% of the actors being connected to one another and gradually dropped throughout the year and ended with 12.9%. Quarter one, week one or Cohort One was the only time the cohort was above the null. Cohort Two started with

35.6% of the actors being connected to each other and had a significant increase in quarter one, week two, then a significant drop ending at 14.5 % of the actors being connected to one another. Although the cohort ended below the null (14.5%), only quarter two, week seven was below the null. The other six weeks were above the null. The density of Cohort Three stated at 36.4% of the actors being connected and dropped to 25.8% of the actors being connected at the end of the year. At no time did density of Cohort Three drop below the null.

Cohort One was below to the null in density for all but one week which may indicate that student actors were complying with the rules of the program and did not go beyond what was required. Cohorts Two and Three were above the null which may indicate that they participated more fully and many have participated beyond the requirements. While rules need to be established at the beginning of the cohort, facilitators might consider relaxing the expectations so that student actors participate more freely.

The reason the density increased creating a higher percentage of connectedness among actors in quarter one, week two, is because in that particular week both facilitators had a significant number of responses to all cohort member. This also cause a significant drop in interactions in quarter two, week seven because the two facilitators did not contribute to the discussion in such a significant way. This will be discussed further in the Outcome of Bliden Hypothesis section. In addition, all cohorts' curriculum were structured the same although the modules were taught in different orders. In quarter one, week one of all cohorts started with a higher percentage of density then when they ended. The reason for this may be due to enthusiasm and excitement of starting a program and desired new learning which created increased interactions (see figure 8).

Figure 8. Density of all three cohorts.



Question 3: How do facilitator interactions in a blended learning program influence the shape and affect of the network?

As mentioned above, out-degrees is the measurement of actors that send out information and in-degree is the measurement of the actors receiving the information. The in-degrees and out-degrees were used in this research to analyze, understand, and draw conclusions about facilitator interaction and the influence of each facilitator for each cohort.

In Cohort One when analyzing the out-degree, facilitators F03 and F01 had the most influence of any actor in quarter one, week one. In quarter one, week two and quarter three, week one, F03 had the most influence in the network over any other actor. During all other weeks of Cohort One, a student actor held the most influence.

Table 11. Out-degree of facilitators of all three cohorts.

	Facilitator	Wk1 Q1	Wk2 Q1	Wk7 Q2	Wk8 Q2	Wk1 Q3	Wk2 Q3	Wk7 Q4	Wk8 Q4
Coht 1	F01	9	4	3	3	4	3	3	3
	F02			7	4				
	F03	13	13	1	3	12	2	3	3
Coht 2	F203		9	2	2	1	4	8	2
	F207	9	9	0	2	8	3	2	0
Coht 3	F303	10	10	3	10	6	3	10	3
	F306	10	10	9	10	10	10	10	10

In Cohort Two when analyzing the out-degree, facilitator F203 had the most influence of any actor in quarter one, week one. In quarter one, week two F203 and F207 had the most influence in the network than any other actor. In quarter three, week one, F207 had the most influence than any other actor. During all other weeks of Cohort Two, a student actor held the most influence. In Cohort Three either or both F303 and F306 held the position of influence in all quarters and all weeks. In table 11 the weeks highlighted in green are the highest areas of influence among all facilitators, facilitators and students alike. When analyzing the out-degrees of facilitators (table 11) for all three cohorts it was determined that facilitator actor had influence in the network.

Based on a conversation with the program director (R. McClure personal communication, December 3, 2013), it was indicated that each facilitator would start each cohort with heavy contributions and they would then gradually move away from their contributing to have less and less with there being the most minimal at the end of the program. In general, evidence does not show that facilitators lessened their contributions or influence giving to the network (out-degree). Facilitator F306 in particular had significant influence throughout the year. There is not evidence that facilitator F306 did not gradually move away from contributing.

There were weeks in which the facilitators' contributions and influences were less than that of a student actor except in Cohort Three but there was not a gradual decrease. The exception to this was facilitator F03, F203, and F303, which was the same facilitator in all three cohorts, who did gradually decrease her contribution.

One suggestion would be that the program chair would coach facilitators on when and how to strategically decrease their participation. Another recommendation would be for facilitators to share the role of facilitation on a rotating basis to share influence more equally.

Table 12. In-degree of facilitators of all three cohorts.

	Facilitator	Wk1 Q1	Wk2 Q1	Wk7 Q2	Wk8 Q2	Wk1 Q3	Wk2 Q3	Wk7 Q4	Wk8 Q4
Coht 1	F01	0	1	0	3	0	0	0	0
	F02			1	2				
	F03	2	1	0	0	1	0	1	0
Coht 2	F203		1	0	1	0	1	0	0
	F205	0	2	0	1	3	0	0	0
Coht 3	F303	1	1	0	1	2	2	0	0
	F306	0	2	2	0	1	1	0	4

On the other hand, the information received from other actors (in-degree) was not significant thereby determining that no facilitator held a position of power. In the discussion with the program director (R. McClure personal communication, December 3, 2013), she had indicated that facilitators were equal members of the cohort and the program was designed for facilitators to have equal weight as any student. The data shown in table 12 would indicate that this was in fact the case.

The program director indicated in conversation on December 3, 2013 that facilitators were treated as a part of the cohort. This finding of in-degrees confirm that facilitators did not hold positions of power and were considered part of the cohort by the student participants. When

analyzing the in-degree (table 12) for all three cohorts it was determined that no facilitator actor had prestige or power in the network at any time.

Outcome of Bliden Hypothesis

It is the hypothesis that SNA might be able to uncover the patterns similar to those that the content analysis of ways of knowing in McWilliams (2014) showed. When using the Bliden hypothesis to apply Drago-Severson's ways of knowing to a social network rather than individual actors, it was necessary to look at the density, centrality, and directionality to understand the shape and the affect. Based on McWilliams (2014) this cohort did not indicate instrumental ways of knowing therefore the hypothesis for this particular way of knowing will not be addressed. The hypotheses for the additional three ways of knowing are listed below.

- **Instrumental:** If the density of the network has a lower percentage (0% to 10%) of actors being connected to each other; the facilitator will have centrality; directionality would be towards centralized persons to seek to deliver what the facilitator wants from them however, the arcs would be between the facilitator and the actor. The inference is that the cohort's way of knowing is Instrumental.
- **Socializing:** If the density of the network has a lower percentage (10% to 20%) of actors being connected to each other; few actors (maybe facilitator) having centrality; directionality would be towards centralized persons to seek approval however, the arcs would be minimal. The inference is that the cohort's way of knowing is Socializing.
- **Self-Authoring:** If the density of the network has average percentage (20% to 40%) of actors being connected to each other; the network has centrality with an average number of arcs and minimal reciprocity. The inference is that the cohort's way of knowing is Self-Authoring.

- **Self-Transforming:** If the density of the network has a high percentage (40% to 60%) of actors being connected to each other; if the network is tighter with shared centrality and a high number of arcs with high reciprocity. The inference is that the cohort's way of knowing is Self-Transforming.

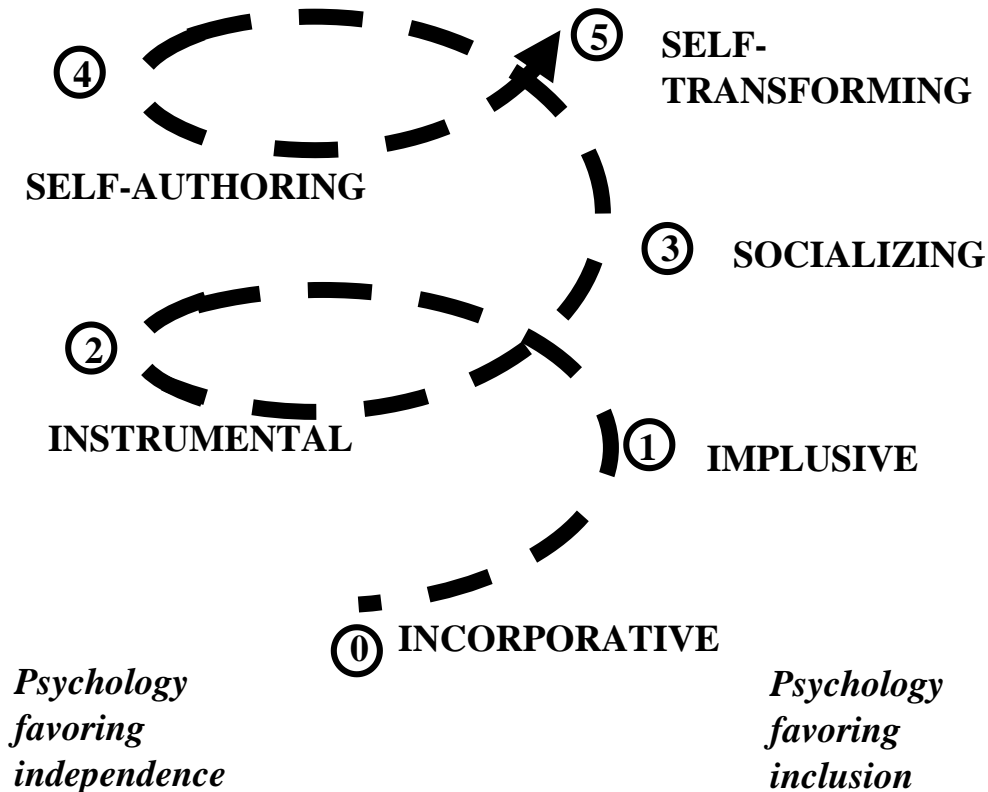
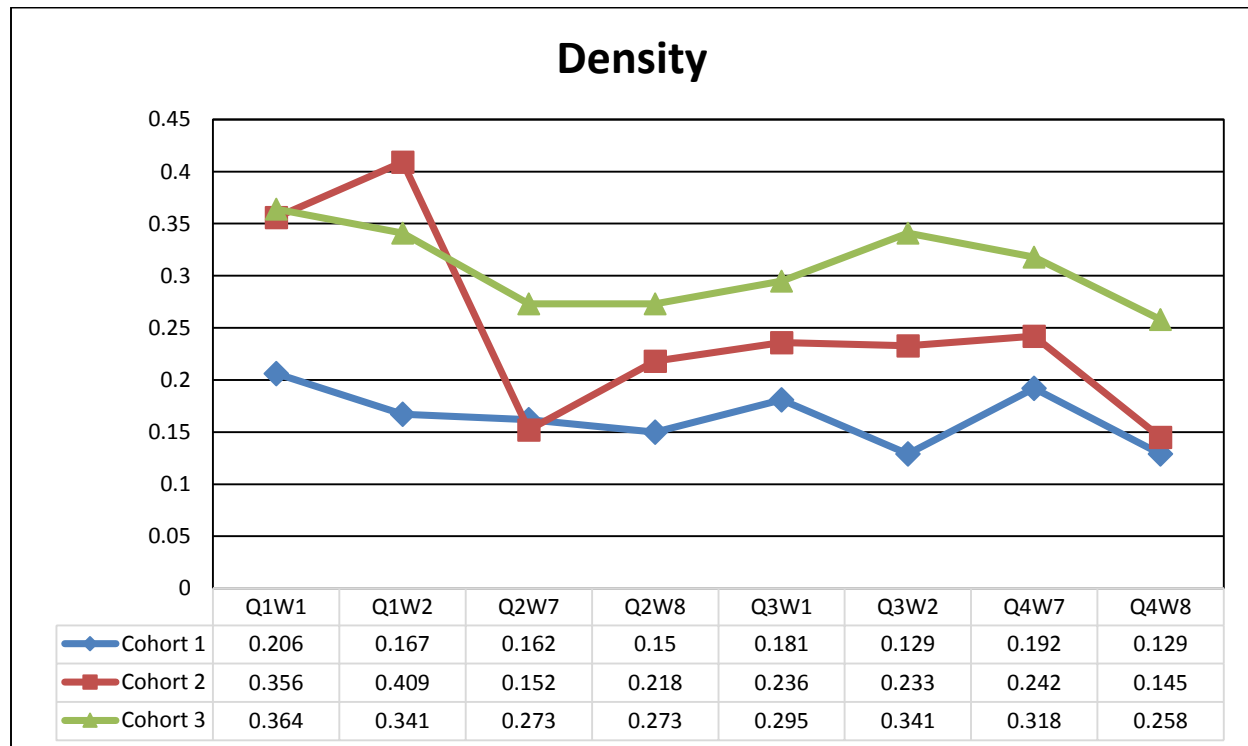


Figure 9: Adapted from Kegan's Order of Consciousness (1982, p. 109)

In addition to analyzing the social network of these three cohorts, in order to further substantiate the hypotheses this researcher looked at McWilliams (2014) research which also used the same data to code and analyze for an individual's way of knowing. Based on the above hypothesis, Cohort One appears as socializing, Cohort Two presents as self-authoring, and Cohort Three seems to be as self-authoring. Neither an instrumental nor a self-transforming way of knowing existed among the cohorts in this research. In addition, when analyzing the density of the cohorts, it could be speculated that the reason every cohort initially started at their highest

density and decreased significantly by the end of the program was due to the actor’s way of knowing during those period of times. At the beginning of the program it is theorized that the actors were eagerly seeking knowledge and wished to interact with other actors in the cohort regularly in order to increase their knowledge. The higher density might indicate that actors were asserting themselves in to a psychological inclusion way of know which is either socializing or self-transforming. At the end of the program the density might indicate that the actors were settling in to a self-authoring way of knowing. Self-authoring way of knowing is psychologically on the independence side of the process of the developmental orders. It is speculated that due to the fact that the program and the cohorts themselves were coming to their end, the actors naturally settled into an independence stage.

Figure 10. Density of all three cohorts.



Located in the Appendix C of McWilliams (2014) are charts of individual actors and their ways of knowing. If this research compares those charts of the ways of knowing percentages as a whole cohort, then charts would collaborate and confirm the hypothesis of this SNA and a cohort's way of knowing as a whole.

Limitations

It is important to note that although the modules taught (table 10) to the cohorts were the same module, these modules were not aligned for the rest of the year across cohorts. For the yearlong program, only Cohorts Two and Three responded to the same prompts in the same order throughout the yearlong cohort. The prompts given to Cohort One were not in the same order or in the same quarter as the other two cohorts thus possibly creating the differences in the responses for any particular week. In order to fully understand the network structure in a particular quarter and compare it to another cohort in the same quarter with the same prompts, all weeks would have to be coded and analyzed across cohorts.

Table 13. Quarters and modules of instruction for all three cohort

Cohort One		Cohorts Two & Three		
Quarters		Quarters		
Winter - 1	Introductory Module	Summer - 1	Introductory Module	Introductory Module
Spring - 2	Student Support Services	Fall - 2	Developing People	Developing People
Summer - 3	Melding Theory and Practice	Winter - 3	Student Support Services	Student Support Services
Fall - 4	Developing People	Spring - 4	Melding Theory and Practice	Melding Theory and Practice

Additionally the work habits of students and time availability may have increased or limited who each student responded to on a regular basis. A majority of the actors work in PreK-

12 public education and therefore there may have been an increase of responses during the summer months when the actors had more time due to their work schedule. More responses during summer may have impacted the results of the network during this time. On the reverse end, the final quarter of each cohort may have resulted in fewer responses thereby lowering the number of average connections if actors were feeling anxious about finishing the program.

Recommendations for Further Research

Further research using social network analysis in blended learning cohorts would inform program directors and facilitator as to how to enhance the learning environment to create greater transformational learners and further develop sustainable and supportive cohorts. This research revealed a considerable findings which answered the research questions but there were many unanswered questions that surfaced during the analysis. These questions were about the relationships and interactions of the actors within each cohort which this research was not designed to answer.

There were several actors in each cohort which included the facilitators which could have either centrality or bridges. Sometimes the same actor held both positions for a particular week. Further research could be to analyze every week to further understand why centrality alternates between actors and does not stay with one actor or a select few actors.

More evidence could be obtained as to why the evolution of the cohorts changed in the matter that they did or why the density changed as it did for each different cohort. The dynamics of the cohort population could have an effect on this change. Further research into the order of the curriculum modules and the prompts created for those modules could reveal more about relationships and beliefs among actors. This research was limited to archived online data. It is

possible that more information could be revealed through gathering data by other means thereby enlarging the understandings about blended learning cohorts. It might be informative for another researcher to code in-person interactions for comparison to the online interactions.

In-degree was described by Hanneman and Riddle (2005) as “Actors that receive information from many sources may be prestigious. Actors that receive information from many sources may also be more powerful – to the extent that knowledge is power. Actors that receive a lot of information could also suffer from information overload or noise and interference due to contradictory messages from different sources” (Basic Demographics, para. 9). In this research there were actors in each week of each cohort that held the highest in-degree position. To determine whether the in-degree actor is either in a position of power and prestige or in information overload is beyond the scope of this research and may be beneficial to conduct further research.

The impact of the power differential between students and facilitators would be of interest to further explore. This research conducted the social network analysis as unweighted however it is possible with different data such as surveys and interviews, it might be determined that a power differential does exist and the SNA could be analyzed through weighted calculations.

Another possible research focus would be to analyze the cohort modules for diffusion. The research could collect and analyze data for one or more of the modules to further understand how information flowed through the cohort during that particular time.

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Appendix A

Appendix A gives the centrality and the distance of all three cohorts in the year long program. The charts below indicate the actors that hold the positions of Centrality, Bridges, Eccentricity, and Closeness for all the weeks that were coded. Chart A1 is Cohort One, Chart A2 is Cohort Two, Chart A3 is Cohort Three.

A1.

	Cohort One	Centrality	Bridges	Eccentricity	Closeness
Qt 1	Coht 1 Wk 1-Winter	F03	F03	S12	S12
	Coht 1 Wk 2-Winter	F03	S10	S02, S05, S12	S12
Qt 2	Coht 1 Wk 7-Spring	S06, F02	S14	S05, S08, S09, F01, F03	F03
	Coht 1 Wk 8-Spring	S10	S09	S01, S03, S08, F01, F03	S08
Qt 3	Coht 1 Wk 1-Summer	F03	S04, S10	S11	S11
	Coht 1 Wk 2-Summer	S09, S06	S01, S02	S05	S05
Qt 4	Coht 1 Wk 7-Fall	S12	S12	S11	S11
	Coht 1 Wk 8-Fall	S01, S06	S06, S05	S09, S11, F03	S07

A2.

	Cohort Two	Centrality	Bridges	Eccentricity	Closeness
Qt 1	Coht 2 Wk 1-Summer	S208	S208	S201	S201
	Coht 2 Wk 2-Summer	S207	S207	S201, S204, S205	S204
Qt 2	Coht 2 Wk 7-Fall	S207	S207, S208	S202, S204	S206
	Coht 2 Wk 8-Fall	S207	S208	S206	S206
Qt 3	Coht 2 Wk 1-Winter	F207	F207	S202	F203
	Coht 2 Wk 2-Winter	S203, S208	S205	S207	S207
Qt 4	Coht 2 Wk 7-Spring	S203, S207	S203	S201, S202, S205, S206, S208, F207	S202
	Coht 2 Wk 8-Spring	S203, S207	S207	S201, S204, S206, S207, S208, F203	S206, F203

A3.

	Cohort Three	Centrality	Bridges	Eccentricity	Closeness
Qt 1	Coht 3 Wk 1-Summer	S309	S304	S306, S301, S302, S303	S301
	Coht 3 Wk 2-Summer	F306	S306	S301, S303, S305, S307	S305
Qt 2	Coht 3 Wk 7-Fall	F306	S303	S302	S309
	Coht 3 Wk 8-Fall	F303	S301	S304	S304
Qt 3	Coht 3 Wk 1-Winter	F306	S303	S310	S310
	Coht 3 Wk 2-Winter	S307	S304	S303, S306, S308, S310	S308
Qt 4	Coht 3 Wk 7-Spring	S310, F303, F306	S305	S304, S305, S308	S308
	Coht 3 Wk 8-Spring	F306	F306	S302, S303, S305, S307, F303	S303,S307

Appendix B

Appendix B gives the in-degrees and out degrees of all actors of all three cohorts in the year long program. The actors highlighted in green are the actors that had the highest degree of influence for that week and the actors that are highlighted in yellow had the highest degree of power for that week. Chart B1 is Cohort One, Chart B2 is Cohort Two, Chart B3 is Cohort Three

B1.

Coht 1	Qt 1, Wk 1		Qt 1, Wk 2		Qt 2, Wk 7		Qt 2, Wk 8	
Node	In-Degree	Out-Degree	In-Degree	Out-Degree	In-Degree	Out-Degree	In-Degree	Out-Degree
S01	6	3	5	2	2	2	4	2
S02	4	3	5	3	4	3	4	3
S03	2	3	4	2	4	3	4	2
S04	4	4	4	3	2	3	3	5
S05	3	5	5	3	2	3	6	3
S06	5	3	5	2	5	3	2	3
S07	7	3	2	3	4	2	2	0
S08	7	2	3	2	4	2	4	2
S09	4	3	4	3	2	2	5	5
S10	4	5	4	4	4	2	2	4
S11	4	3	2	3	4	3	2	3
S12	4	1	4	2	3	3	3	4
S13	7	3	2	2				
S14					3	2		
	Qt 3, Wk 1		Qt 3, Wk 2		Qt 4, Wk 7		Qt 4, Wk 8	
Node	In-Degree	Out-Degree	In-Degree	Out-Degree	In-Degree	Out-Degree	In-Degree	Out-Degree
S01	4	2	2	2	3	2	4	2
S02	3	2	2	2	3	1	2	0
S03	3	2	2	3	3	2	2	2
S04	4	2	1	2	2	5	1	3
S05	2	2	2	2	5	2	3	2
S06	3	0	3	2	3	2	4	2
S07	1	0	0	0	4	2	2	1
S08	4	2	2	1	2	2	2	2
S09	2	2	4	2	2	2	2	2
S10	5	2	4	2	2	2	3	0
S11	4	2	3	1	2	1	0	2
S12	2	4	2	3	3	6	2	3

B3.

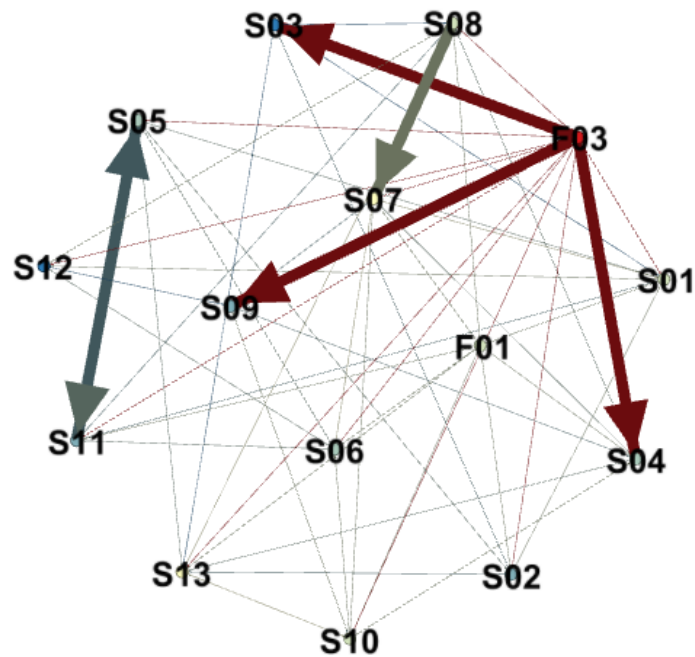
Table Coht 2	Qt 1, Wk 1		Qt 1, Wk 2		Qt 2, Wk 7		Qt 2, Wk 8	
Node	In-Degree	Out-Degree	In-Degree	Out-Degree	In-Degree	Out-Degree	In-Degree	Out-Degree
301	6	2	5	2	4	2	4	2
S302	6	3	4	3	3	2	3	1
S303	5	2	4	3	6	2	3	2
S304	5	5	4	0	3	1	4	2
S305	4	3	2	1	3	2	3	0
S306	4	2	7	4	4	6	4	2
S307	3	2	4	2	5	2	4	2
S308	2	0	5	2	1	3	2	0
S309	7	6	4	6	3	2	3	3
S310	5	3	3	2	2	2	5	2
	Qt 3, Wk 1		Qt 3, Wk 2		Qt 4, Wk 7		Qt 4, Wk 8	
Node	In-Degree	Out-Degree	In-Degree	Out-Degree	In-Degree	Out-Degree	In-Degree	Out-Degree
S301	3	2	5	3	2	2	1	0
S302	2	2	4	2	3	3	4	3
S303	6	3	3	3	4	2	3	2
S304	3	3	5	5	2	2	5	0
S305	3	3	2	2	5	2	1	3
S306	4	2	4	2	4	3	3	2
S307	5	2	8	4	5	2	3	2
S308	1	1	4	1	5	1	2	2
S309	4	3	2	8	5	2	5	4
S310	5	2	5	2	7	3	3	3

Appendix C

Appendix C gives all the data that was analyze for every actors for all three cohorts in the year long program. Each page below is one week for one cohort with the data chart and the visualization for that week. Chart C1 is Cohort One, quarter one, week one. Each corresponding chart and visualization is sequentially in order by cohort, quarter and week. Each chart is labeled for further clarification.

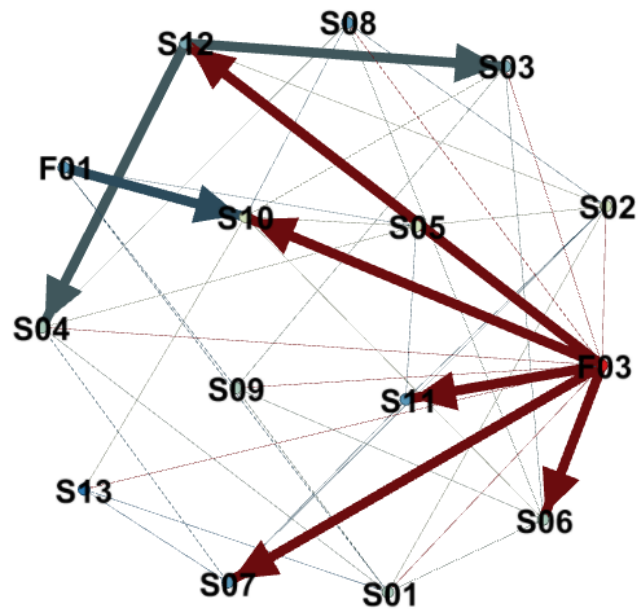
C1. Cohort One, Quarter one, Week one

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S01	9	2	1.76	31.55	6	3
S02	7	3	2.07	8.85	4	3
S03	5	3	2.15	1.53	2	3
S04	8	3	2.00	4.78	4	4
S05	8	3	1.76	7.90	3	5
S06	8	4	2.30	11.71	5	3
S07	10	3	2.23	25.08	7	3
S08	9	4	2.69	7.66	7	2
S09	7	4	2.38	17.00	4	3
S10	9	3	1.84	10.13	4	5
S11	7	3	2.07	7.60	4	3
S12	5	5	3.15	9.21	4	1
S13	10	2	1.76	24.23	7	3
F01	9	2	1.35	0.00	0	9
F03	15	1	1.00	35.73	2	13



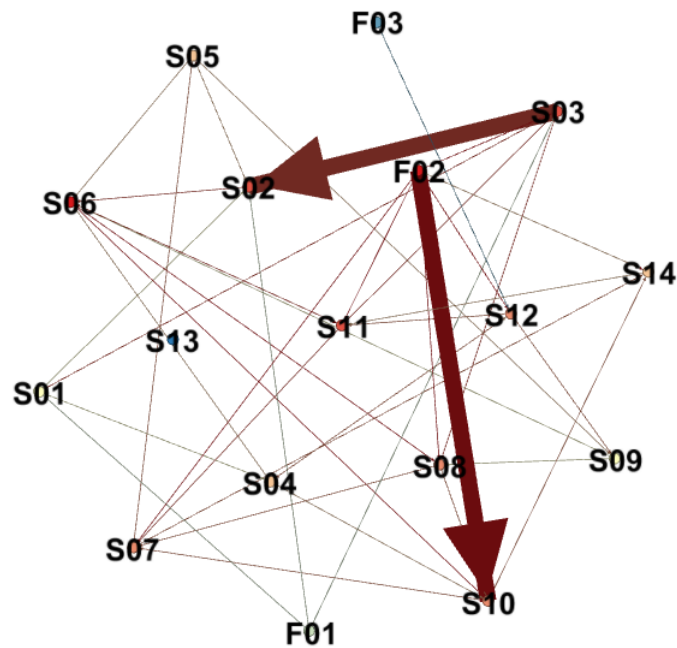
C2. Cohort One, Quarter one, Week two

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S01	7	6	3.00	22.41	5	2
S02	8	7	3.00	12.75	5	3
S03	6	6	3.07	12.00	4	2
S04	7	6	2.642	19.25	4	3
S05	8	7	3.14	15.91	5	3
S06	7	5	2.71	32.66	5	2
S07	5	4	2.28	28.50	2	3
S08	5	5	2.57	21.66	3	2
S09	7	6	2.71	20.00	4	3
S10	8	4	2.00	54.58	4	4
S11	5	3	1.85	16.83	2	3
S12	6	7	3.21	5.83	4	2
S13	4	3	2.35	34.5	2	2
F01	5	5	2.214	10.91	1	4
F03	14	2	1.07	12.16	1	13



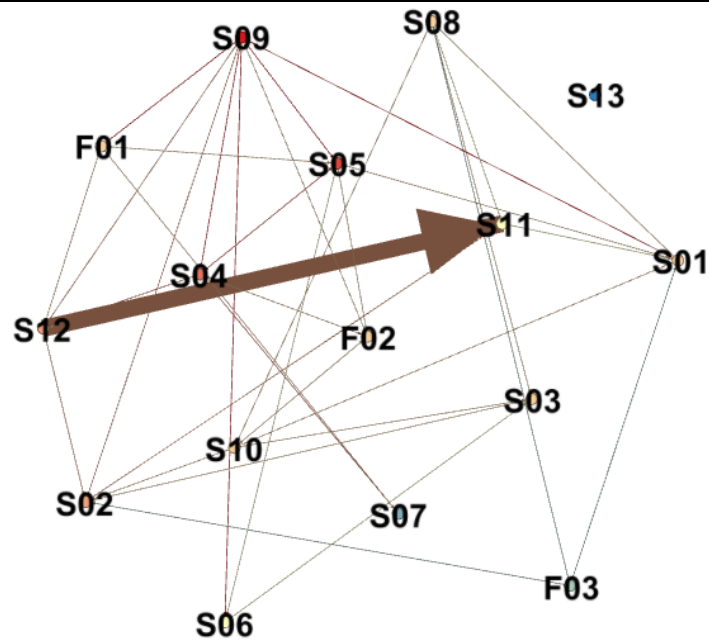
C3. Cohort One, Quarter two, Week seven

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S01	4	4	2.38	11.83	2	2
S02	7	4	2.30	17.40	4	3
S03	7	4	2.23	32.08	4	3
S04	5	4	2.30	16.50	2	3
S05	5	5	2.53	17.06	2	3
S06	8	4	2.53	26.33	5	3
S07	6	4	2.46	29.03	4	2
S08	6	5	3.00	13.33	4	2
S09	4	5	3.00	3.75	2	2
S10	6	4	2.61	26.13	4	2
S11	7	4	2.15	31.80	4	3
S12	6	4	2.23	23.66	3	3
S13	0	0	0.00	0.00	0	0
S14	5	3	2.23	33.26	3	2
F01	3	5	2.50	0.00	0	3
F02	8	2	1.46	20.80	1	7
F03	1	5	3.07	0.00	0	1



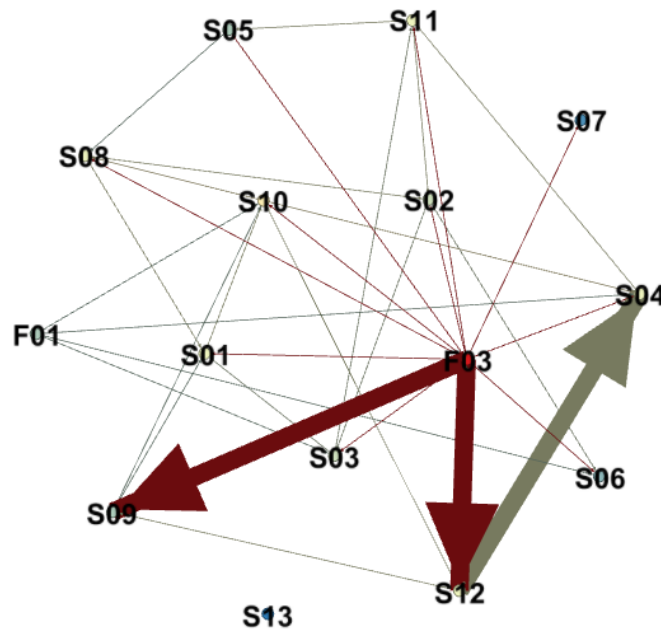
C4. Cohort One, Quarter two, Week eight

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S01	6	4	2.38	10.06	4	2
S02	7	3	2.00	23.55	4	3
S03	6	4	2.53	10.31	4	2
S04	8	3	1.76	22.75	3	5
S05	9	3	2.15	20.38	6	3
S06	5	3	2.15	6.16	2	3
S07	2	0	0.00	0.00	2	0
S08	6	4	2.76	15.83	4	2
S09	10	3	1.84	30.45	5	5
S10	6	3	2.00	17.43	2	4
S11	5	3	2.07	11.00	2	3
S12	7	3	1.84	18.41	3	4
S13	0	0	0.00	0.00	0	0
F01	6	4	2.23	9.91	3	3
F02	6	3	1.84	11.71	2	4
F03	3	4	2.28	0.00	0	3



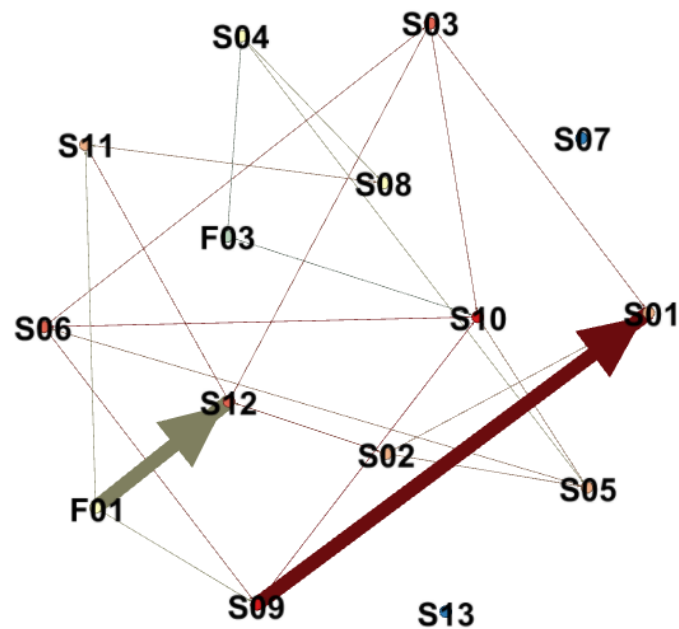
C5. Cohort One, Quarter three, Week one

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S01	6	5	2.91	34.00	4	2
S02	5	7	3.58	19.50	3	2
S03	5	6	3.00	17.83	3	2
S04	6	3	2.25	42.83	4	2
S05	4	7	3.58	4.83	2	2
S06	3	0	0.00	0.00	3	0
S07	1	0	0.00	0.00	1	0
S08	6	6	3.16	22.33	4	2
S09	4	5	3.00	1.00	2	2
S10	7	4	2.41	42.16	5	2
S11	6	8	4.00	14.50	4	2
S12	6	2	1.66	32.66	2	4
F01	4	4	2.15	0.00	0	4
F03	13	1	1.00	18.33	1	12



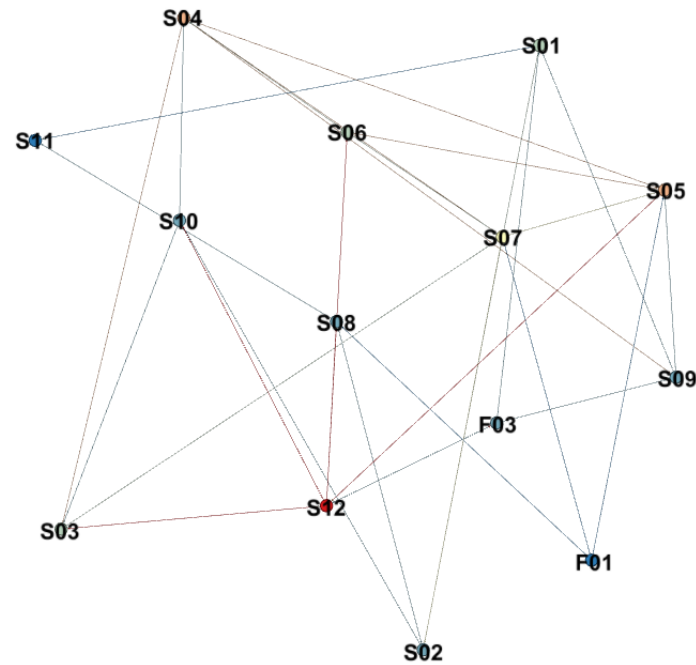
C6. Cohort One, Quarter three, Week two

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S01	4	4	2.33	28.66	2	2
S02	4	3	2.11	28.5	2	2
S03	5	5	2.44	11.66	2	3
S04	3	6	2.90	3.00	1	2
S05	4	7	3.44	10.50	2	2
S06	5	6	3.11	12.50	3	2
S07	0	0	0.00	0.00	0	0
S08	3	1	1.00	2.00	2	1
S09	6	5	2.66	21.83	4	2
S10	6	6	3.11	13.83	4	2
S11	4	1	1.00	9.00	3	1
S12	5	3	1.77	20.50	2	3
F01	3	3	1.90	0.00	0	3
F03	2	5	2.54	0.00	0	2



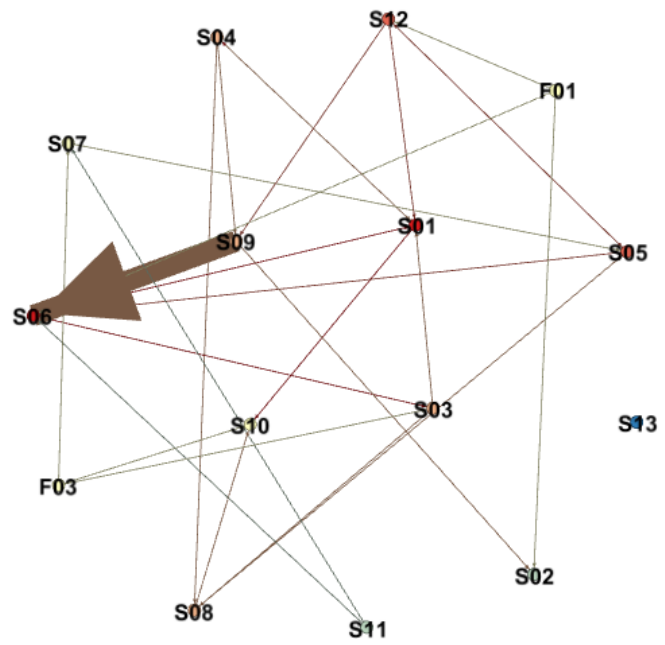
C7. Cohort One, Quarter four, Week seven

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S01	5	5	3.33	18.50	3	2
S02	4	5	3.08	33.83	3	1
S03	5	3	2.16	21.83	3	2
S04	7	3	1.91	29.16	2	5
S05	7	3	2.16	25.33	5	2
S06	5	4	2.58	9.83	3	2
S07	6	4	2.66	8.66	4	2
S08	4	5	3.08	9.33	2	2
S09	4	3	2.33	7.50	2	2
S10	4	4	2.33	39.83	2	2
S11	3	6	4.25	2.00	2	1
S12	9	2	1.50	47.83	3	6
F01	3	4	2.30	0.00	0	3
F03	4	3	1.91	7.33	1	3



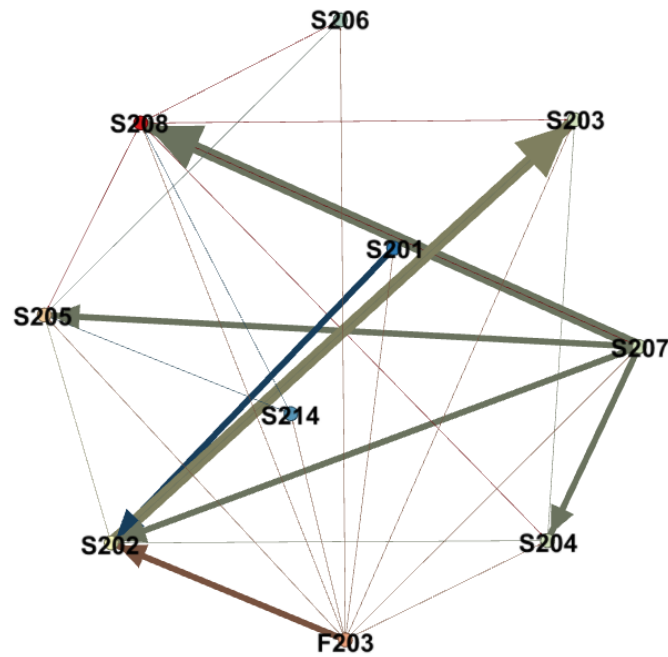
C8. Cohort One, Quarter four, Week eight

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S01	6	4	2.55	25.00	4	2
S02	2	0	0.00	0.00	2	0
S03	4	4	2.33	14.00	2	2
S04	4	3	1.88	14.00	1	3
S05	5	3	2.22	28.00	3	2
S06	6	4	2.44	28.50	4	2
S07	3	4	3.00	7.00	2	1
S08	4	4	2.55	12.00	2	2
S09	4	5	2.66	15.00	2	2
S10	3	0	0.00	0.00	3	0
S11	2	5	2.63	0.00	0	2
S12	5	3	1.88	15.50	2	3
S13	0	0	0.00	0.00	0	0
F01	3	3	2.00	0.00	0	3
F03	3	5	2.45	0.00	0	3



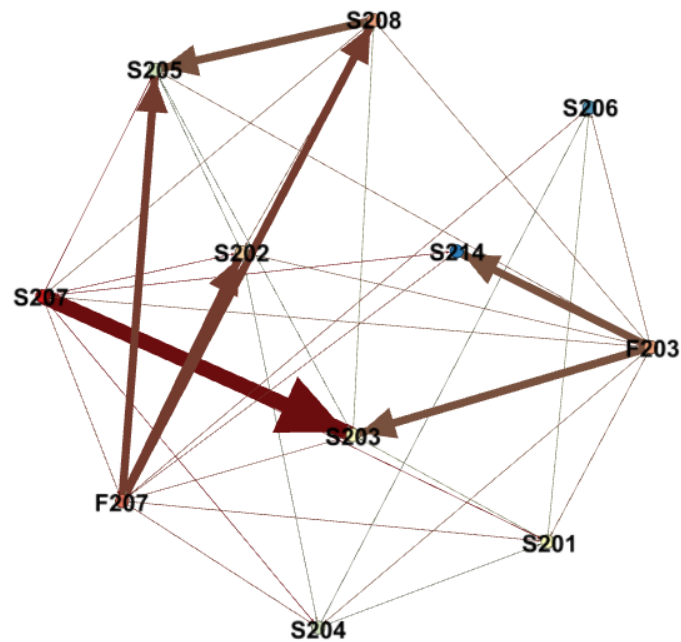
C9. Cohort Two, Quarter one, Week one

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S201	2	4	2.71	0.00	1	1
S202	7	3	2.00	7.33	5	2
S203	6	2	1.66	4.33	4	2
S204	6	2	1.50	1.66	3	3
S205	8	3	1.83	6.00	6	2
S206	5	3	1.83	0.00	3	2
S207	6	2	1.33	1.33	2	4
S208	12	2	1.16	23.33	7	5
S214	3	3	1.85	0.00	1	2
F203	9	1	1.00	0.00	0	9



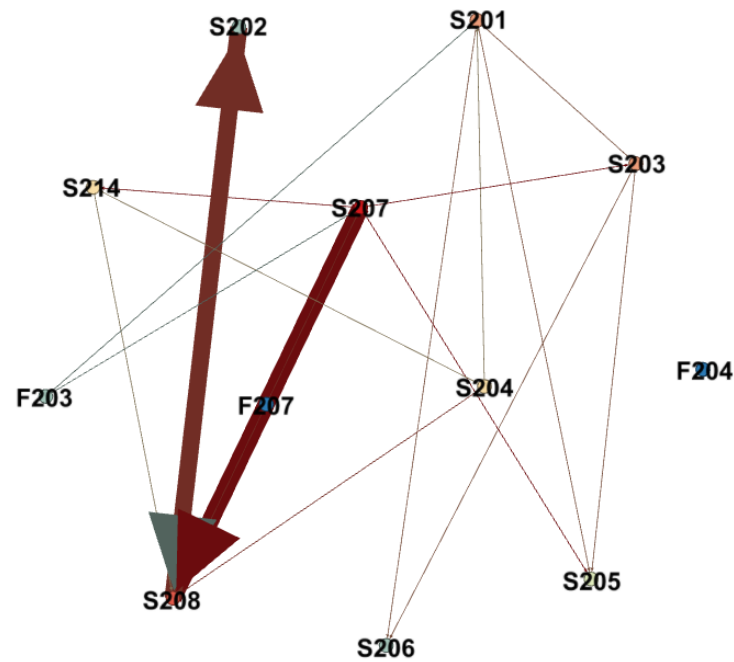
C10. Cohort Two, Quarter one, Week two

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S201	8	3	1.80	4.41	5	3
S202	9	2	1.70	8.25	6	3
S203	8	2	1.70	3.00	5	3
S204	7	3	2.00	1.58	4	3
S205	7	3	1.90	0.33	4	3
S206	4	0	0.00	0.00	4	0
S207	13	2	1.20	14.00	5	8
S208	10	2	1.60	10.58	6	4
S214	3	0	0.00	0.00	3	0
F203	10	2	1.10	3.16	1	9
F207	11	2	1.10	5.66	2	9



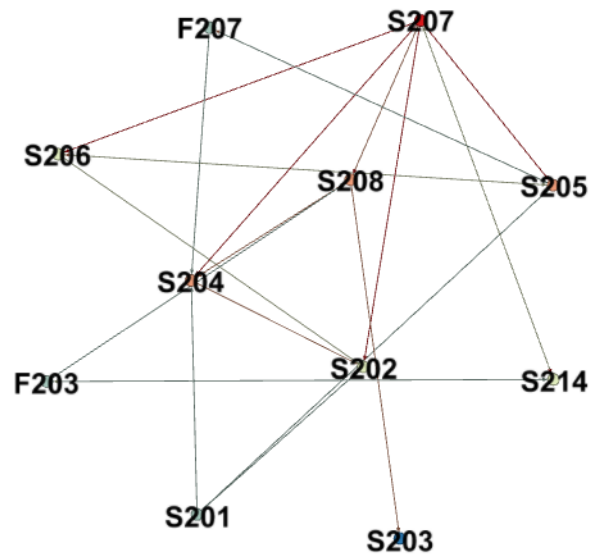
C11. Cohort Two, Quarter two, Week

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S201	5	1	1.00	6.00	3	2
S202	2	4	2.62	0.00	1	1
S203	5	3	1.75	3.00	1	4
S204	4	4	2.25	6.50	2	2
S205	3	0	0.00	0.00	3	0
S206	2	0	0.00	0.00	2	0
S207	7	2	1.50	18.00	3	4
S208	6	3	1.75	18.00	3	3
S214	4	3	2.12	5.50	2	2
F203	2	3	2.00	0.00	0	2
F207	0	0	0.00	0.00	0	0



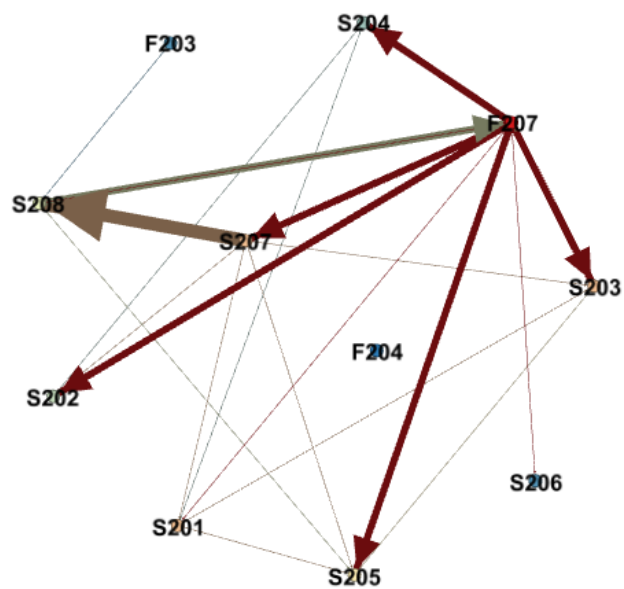
C12. Cohort Two, Quarter two, Week eight

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S201	3	5	2.40	0.00	0	3
S202	4	0	0.00	0.00	4	0
S203	1	0	0.00	0.00	1	0
S204	6	4	2.55	21.83	4	2
S205	6	6	3.11	15.00	4	2
S206	4	7	3.77	1.00	2	2
S207	8	2	1.33	28.16	2	6
S208	6	3	1.88	29.66	3	3
S214	4	3	2.00	9.33	2	2
F203	3	4	2.33	1.00	1	2
F207	3	5	2.55	12.00	1	2



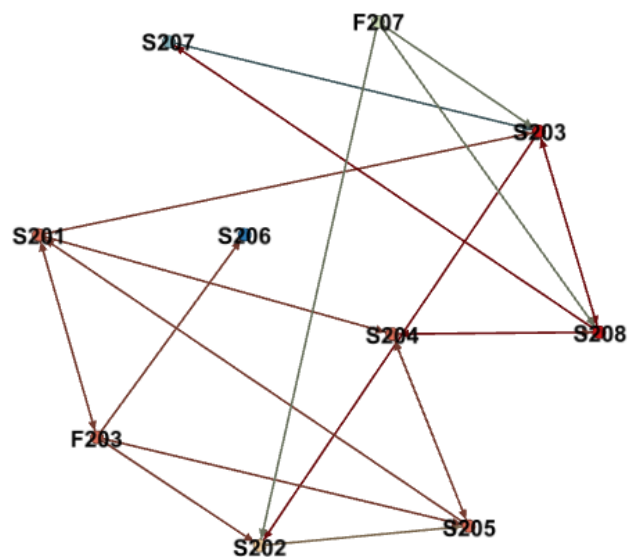
C13. Cohort Two, Quarter three, Week one

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S201	7	2	1.62	6.50	4	3
S202	4	4	2.50	1.50	3	1
S203	7	2	1.62	9.00	4	3
S204	3	3	2.00	0.00	1	2
S205	6	3	2.50	1.00	5	1
S206	1	0	0.00	0.00	1	0
S207	7	3	1.62	7.50	2	5
S208	5	2	1.75	10.00	3	2
F203	1	3	2.55	0.00	0	1
F207	11	1	1.00	31.50	3	8



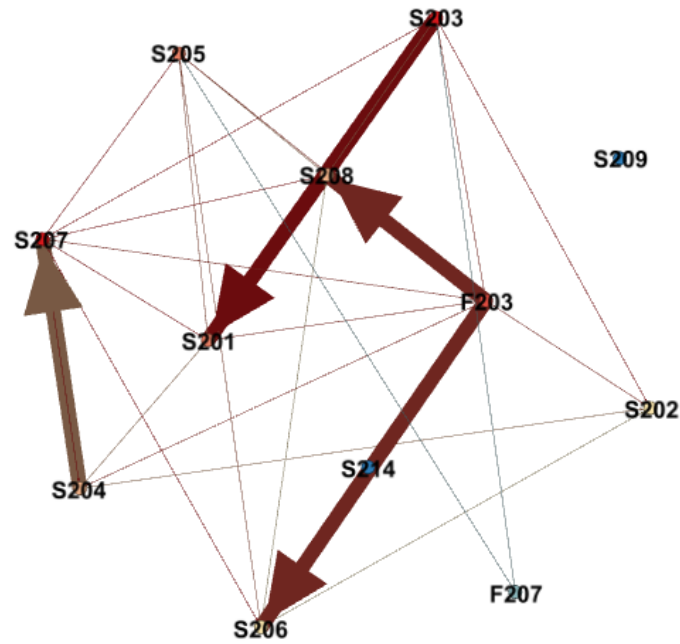
C14. Cohort Two, Quarter three, Week two

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S201	5	3	1.75	19.83	2	3
S202	4	4	2.75	12.00	3	1
S203	6	5	2.50	11.66	4	2
S204	5	4	2.25	10.83	3	2
S205	5	3	2.12	23.16	3	2
S206	1	0	0.00	0.00	1	0
S207	2	6	3.25	0.00	1	1
S208	6	5	2.37	12.00	3	3
F203	5	4	1.87	9.50	1	4
F207	3	5	2.33	0.00	0	3



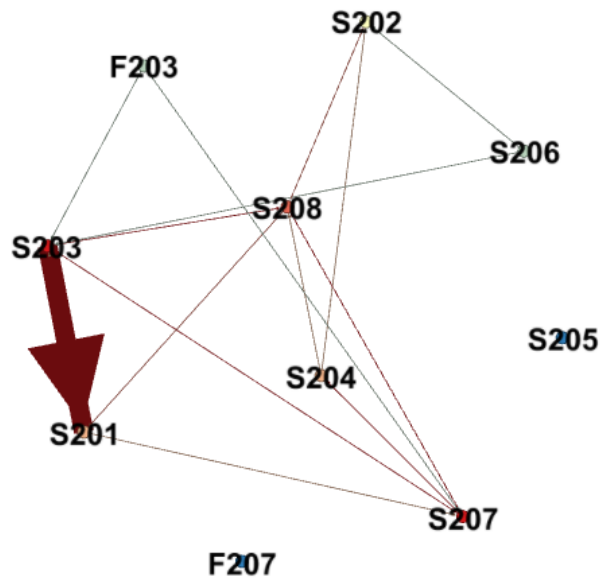
C15. Cohort Two, Quarter four, Week seven

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S201	7	3	1.85	4.33	5	2
S202	5	3	2.42	4.83	4	1
S203	9	2	1.42	14.16	5	4
S204	6	2	1.57	7.16	3	3
S205	7	3	2.00	4.33	5	2
S206	5	3	2.00	3.33	3	2
S207	9	2	1.14	9.33	3	6
S208	6	3	1.85	3.50	4	2
F203	8	1	1.00	0.00	0	8
F207	2	3	1.87	0.00	0	2



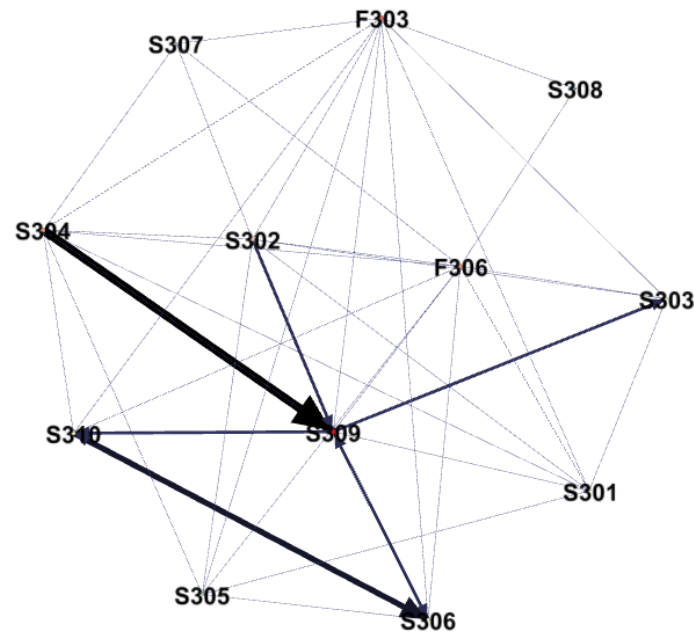
C 16 Cohort Two, Quarter four, Week eight

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S201	4	3	1.80	5.00	2	2
S202	3	0	0.00	0.00	3	0
S203	6	2	1.40	6.66	3	3
S204	4	3	1.60	1.16	1	3
S205	0	0	0.00	0.00	0	0
S206	2	3	1.83	0.00	0	2
S207	6	3	1.80	7.33	4	2
S208	5	3	1.80	6.83	3	2
F203	2	3	1.833333333	0.00	0	2
F207	0	0	0.00	0.00	0	0



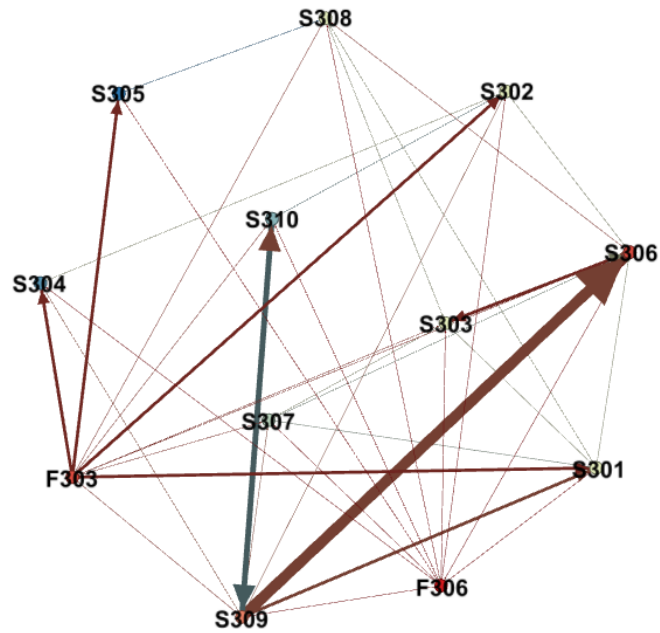
C17. Cohort Three, Quarter one, Week

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S301	8	5	2.60	3.83	6	2
S302	9	5	2.30	4.16	6	3
S303	7	5	2.40	2.50	5	2
S304	10	3	1.60	25.16	5	5
S306	7	5	2.30	1.50	4	3
S305	6	4	2.20	7.33	4	2
S307	5	2	1.80	17.00	3	2
S308	2	0	0.00	0.00	2	0
S309	13	4	1.70	21.83	7	6
S310	8	4	2.00	2.16	5	3
F303	11	1	1.00	14.50	1	10
F306	10	2	1.09	0.00	0	10



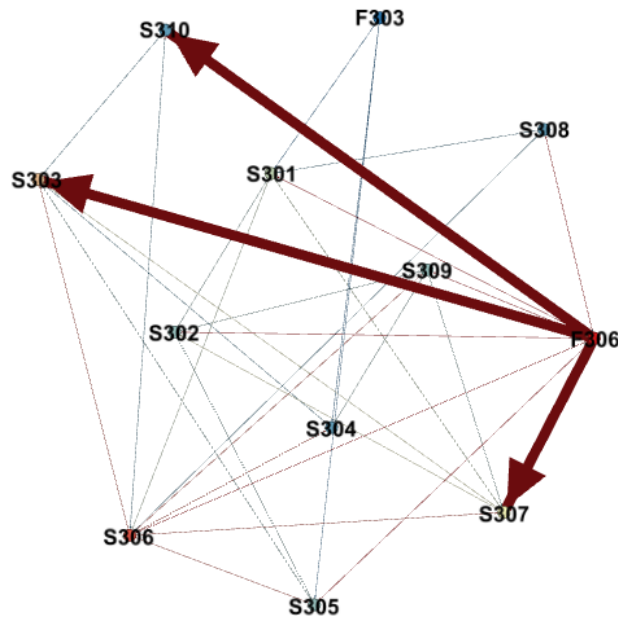
C18. Cohort Three, Quarter one, Week two

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S301	7	4	2.45	1.75	5	2
S302	7	2	1.72	13.16	4	3
S303	7	4	2.27	4.06	4	3
S304	4	0	0.00	0.00	4	0
S305	3	4	2.72	0.00	2	1
S306	11	3	1.72	29.93	7	4
S307	6	4	2.36	0.00	4	2
S308	7	3	1.90	13.73	5	2
S309	10	3	1.54	12.53	4	6
S310	5	3	2.18	0.00	3	2
F303	11	2	1.09	7.58	1	10
F306	12	2	1.09	28.23	2	10



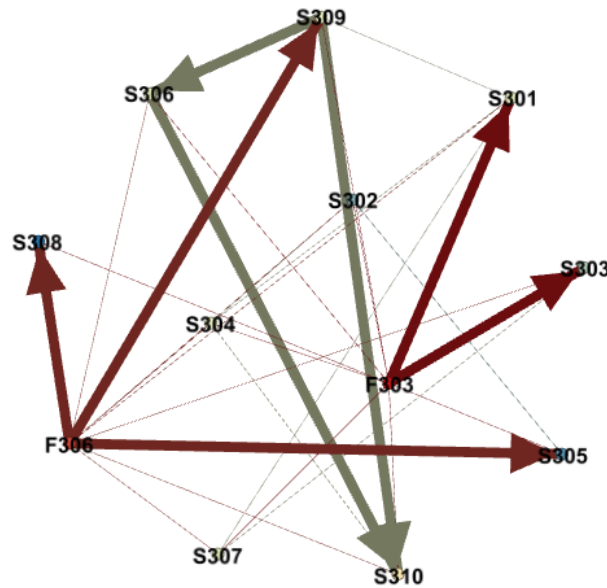
C19. Cohort Three, Quarter two, Week seven

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S301	6	4	2.10	10.16	4	2
S302	5	5	2.60	9.50	3	2
S303	8	3	1.90	35.00	6	2
S304	4	3	2.60	5.08	3	1
S305	5	3	2.20	4.08	3	2
S306	10	3	1.60	18.08	4	6
S307	7	3	2.30	11.50	5	2
S308	4	2	1.70	0.00	1	3
S309	5	4	2.80	6.00	3	2
S310	4	3	2.10	0.00	2	2
F303	3	4	2.18	0.00	0	3
F306	11	2	1.10	33.58	2	9



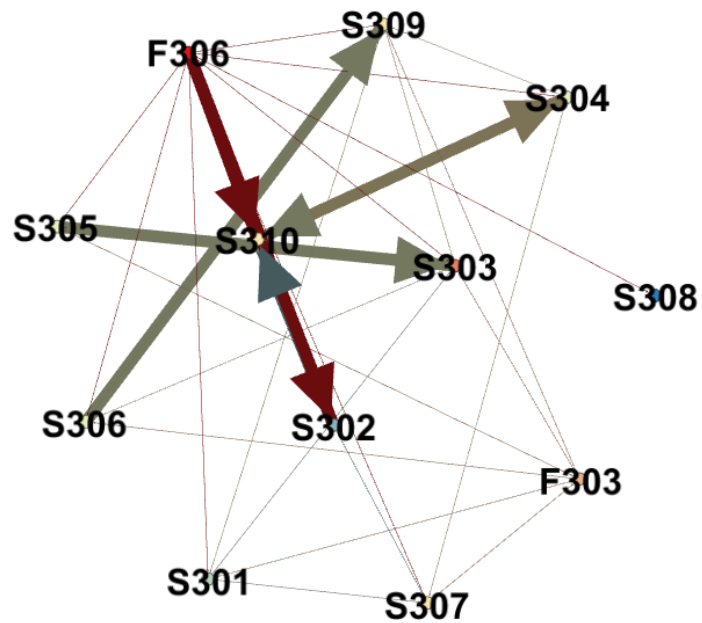
C20. Cohort Three, Quarter two, Week eight

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S301	6	4	2.50	19.50	4	2
S302	4	1	1.00	5.00	3	1
S303	5	2	1.80	17.50	3	2
S304	6	8	3.90	11.50	4	2
S305	3	0	0.00	0.00	3	0
S306	6	6	3.10	12.50	4	2
S307	6	3	2.40	16.00	4	2
S308	2	0	0.00	0.00	2	0
S309	6	5	2.60	15.00	3	3
S310	7	7	3.40	13.00	5	2
F303	11	1	1.00	18.00	1	10
F306	10	2	1.09	0.00	0	10



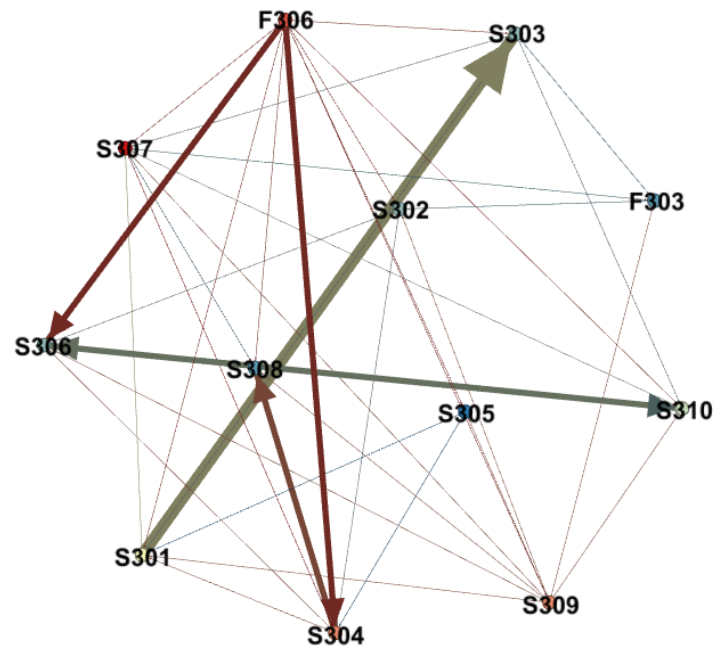
C21. Cohort Three, Quarter three, Week one

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S301	5	3	2.00	3.00	3	2
S302	4	3	2.33	1.66	2	2
S303	9	3	1.88	15.66	6	3
S304	6	3	1.77	9.5	3	3
S305	6	2	1.66	5.33	3	3
S306	6	3	2.22	1.83	4	2
S307	7	3	1.88	15.00	5	2
S308	2	3	2.00	0.00	1	1
S309	7	3	2.00	9.33	4	3
S310	7	4	2.44	13.00	5	2
F303	8	3	1.44	14.66	2	6
F306	11	2	1.09	10.00	1	10



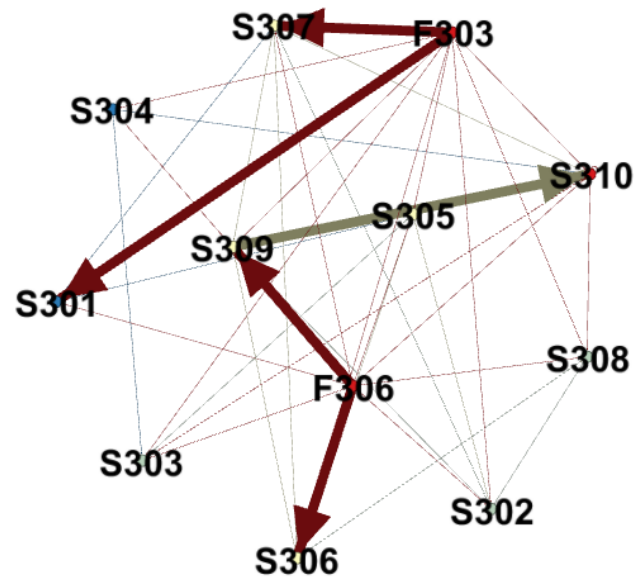
C22. Cohort Three, Quarter three, Week two

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S301	8	3	2.00	6.55	5	3
S302	6	3	1.90	13.86	4	2
S303	6	4	2.27	2.40	3	3
S304	10	2	1.54	32.90	5	5
S305	4	3	2.18	0.50	2	2
S306	6	4	2.45	5.11	4	2
S307	12	3	1.81	31.00	8	4
S308	5	4	2.72	0.00	4	1
S309	10	3	1.36	10.43	2	8
S310	7	4	2.36	5.18	5	2
F303	5	3	2.00	8.23	2	3
F306	11	2	1.09	12.81	1	10



C23. Cohort Three, Quarter four, Week seven

Node	Bridges	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S301	4	3	2.00	0.00	2	2
S302	6	3	1.71	5.00	3	3
S303	6	3	2.00	5.83	4	2
S304	4	4	2.50	0.00	2	2
S305	7	4	2.14	17.00	5	2
S306	7	3	1.85	13.66	4	3
S307	7	3	2.00	7.33	5	2
S308	6	4	2.71	5.66	5	1
S309	7	3	1.85	11.50	5	2
S310	10	3	2.14	13.00	7	3
F303	10	1	1.00	0.00	0	10
F306	10	1	1.00	0.00	0	10



C24. Cohort Three, Quarter four, Week eight

Node	Centrality	Eccentricity	Closeness	Bridges	In-Degree	Out-Degree
S301	1	0	0.00	0.00	1	0
S302	7	3	2.20	5.50	4	3
S303	5	3	2.30	1.00	3	2
S304	5	0	0.00	0.00	5	0
S305	4	3	2.00	0.00	1	3
S306	5	2	1.80	7.50	3	2
S307	5	3	2.30	1.33	3	2
S308	4	2	1.80	2.50	2	2
S309	9	2	1.60	23.33	5	4
S310	6	2	1.70	3.00	3	3
F303	3	3	1.90	0.00	0	3
F306	14	1	1.00	42.83	4	10

