Roles, Relationships, and Power: The Patterns of Knowledge Co-Construction in an Online Educational Leadership Course

by

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A dissertation submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Auburn, Alabama
August 8, 2020

Keywords: interaction analysis model, co-construction of knowledge, distance learning, educational leadership, social network analysis, mixed method

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Abstract

Social interaction is an essential component of learning, but the online learning environment presents challenges to creating meaningful interactions (Palloff & Pratt, 2003; Simonsen, 2015). Researchers have long sought to improve online learning by promoting higher quality interaction. One thread of this research places social knowledge co-construction at the apex of learning quality indicators (Aviv et al., 2003; Schellens & Valcke, 2007; De Wever et al., 2009; Hull & Saxon, 2009). As students negotiate meaning and co-construct new knowledge, their discussion is a "subtle political interaction that brings many aspects of power, motivation and persuasion into play" (Stahl, 2003, p. 5). The dynamics of power in the co-construction of knowledge is an understudied area that should be explored so that instructors and instructional designers can continue to improve the quality of online learning.

The purpose of this concurrent mixed-methods design was to examine ways in which differences in experience levels, patterns of participation, and fulfillment of assigned roles shape the patterns and degree of social knowledge co-construction achieved by graduate student professionals enrolled in online educational leadership course. Online course assignments were of two types, weekly paired case study discussions and whole-group major case study analyses. This provided two distinct datasets to address the study's two research questions.

In the weekly case study discussions, students were randomly paired and tasked to discuss an educational leadership case study. Each case study concerned topics found in various k-12 school settings and was tied to a particular leadership theory, which the course introduced. The level of social knowledge co-construction achieved by each pair was compared with the degree of power parity within each pair. Results found a small but statistically significant relationship between knowledge co-construction and power parity.

In the major case study analyses, students were assigned to specialized discussion roles on a rotational basis. Analysis was split into phases with specified goals and instructions to move the analysis from problem identification through resolution. The discussion transcripts were evaluated for individual contributions to social knowledge co-construction. Social network analysis results found that when students assigned to serve as discussion catalysts, that is students tasked to identify and explore sources of disagreement or contention, made greater contributions to co-construction, more students made greater contributions overall. Likewise, a positive relationship was found between levels of participation and levels of knowledge co-construction.

This study made several contributions to the current literature. It is the first known study to explore the potential effects of power parity on social knowledge co-construction. It demonstrated a novel method to improve how individual contributions to knowledge co-construction can be measured. It provided further evidence of the value of students performing specialized discussion roles. Finally, it presented conditions under which it may be possible to use social network analysis as an efficient way to estimate knowledge co-construction at both individual and class levels of analysis.

Acknowledgements

There is so great a number of people deserving of my gratitude that I fear it may be impossible to give a true accounting. I shall try my best just the same.

I shall begin with my esteemed committee. My chair, Dr. Ellen Hahn, not only supported my research ideas from the beginning, she lured me to Auburn years ago with a College of Education coffee mug. Dr. Lisa Kensler helped shape my conceptual framework and taught me how to develop a line of inquiry using the four-frames analysis. My methodologists were essential to my success. Dr. David Shannon's patient and collegial leadership set the stage for balancing my enthusiasm with rigor. With the exception of one painful instance in which he distributed University of Virginia pencils the day after that school eliminated Auburn from the Final Four, Dr. Shannon always put the needs of his students first. Dr. David Marshall allowed me to develop my ideas in his class and then provided detailed feedback to improve my work. As a Virginia Tech Hokie, Dr. Marshall modeled the grace required for working closely with a UVA graduate. Dr. Andrew Pendola helped me improve my model by identifying exogeneous factors I had overlooked. Dr. Nicholas Derzis graciously agreed to serve as my university reader and did so on short notice. Although not a member of my committee, Dr. Jason Bryant collaborated with me on the course design and treated me like a colleague, allowing me to shape the design of his signature course. Without his support, this effort would not have gotten off the ground. Additionally, Dr. Strom and Dr. Forbes took time to discuss my design with me and provided me further encouragement.

Life at Auburn is all about a shared experience. Therefore, I must acknowledge my cohort, especially Liz Parker, Brandi Howard, Suzanne Dickenson, Mary Kelly, Lindy

Summerlin, and Houda Al-Housini. These friends and colleagues provided me a second family and a true sense of belonging (S. Slear, 2019).

My research relied directly on the talented pool of participants who braved an unfamiliar learning environment and approached non-traditional learning activities with an open mind and a willingness to grow. I would love to acknowledge them by name but doing so would violate the terms of my protocol as approved by my institutional review board.

Many folks outside Auburn supported and encouraged me as well. First, my mentor and friend Dr. Daniel Connelly and his family provided a vibrant source of intellectual and spiritual support. Ms. Carolyn Knutson-Vaccaro, my colleague and friend always had my back at work and encouraged my research. Dr. Jim Waite, lifelong educator and father of my best friend James, read the early drafts of my work and gave me confidence that I was on the right track. Dr. Patricia Maggard, who first introduced me to adult learning, was generous with her time and provided valuable feedback in preparation for my general oral exams. Colonels David Lass and Wayne Straw gave me the incredible opportunity to attend Auburn in the course of my military duty. Dr. Charlotte Gunawardena, a distinguished researcher from the University of New Mexico, gave me the honor of discussing my research, which was centered around the model she pioneered years ago. Her pupil Dr. David Gomez gave me even more of his time and over the course of an entire year, helped me distill my research interests down to a manageable line of inquiry.

Long before I began my journey at Auburn, my parents Jim and Marie believed in me and supported me. They sacrificed financially so that I could receive a quality Catholic education at St. Anthony's High School. In spite of how in my selfishness, I squandered so much opportunity there, I was nonetheless transformed by several phenomenal teachers, such as

Brother Joshua, the greatest math teacher on the planet, Brother Vincent, the kindest and most humble man I have ever met, Ms. Denise Creighton, scholar and friend, and Sister Margaret McKenna who unceasingly reminded me of my need of repentance. My parents did not live to see me complete my education, but my three older sisters, Joanne, Kathleen, and Geralyn and my brothers-in-law Kevin and Anthony believed in me and never fail to remind me of how proud my parents would be. Although my parents were lost early in my adult life, my in-laws Beverly and Ed Phillips gave me all the love and support parents can provide.

With me since the invention of the mixed tape, my wife Susie, the love of my life and the greatest treasure God ever entrusted to me, has been my constant partner. This is not the place to even outline the many ways in which her love has sustained me through life, so I will focus on the academic. Since our junior year of high school, we have tackled our academic challenges together from avoiding summer school to completing our dissertations. We have at once been each other's toughest critics and staunchest advocates. Although we rely constantly on each other, we are not alone. Our daughters Kristine and Katie have been such amazing sources of love and support. They are models of fidelity and perseverance. While accepting themselves for who they are, they strive continuously for self-improvement, tackling one challenge after the next.

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Chapter I: Introduction

This study sought to extend understanding of how individual roles and relationships of power, existing between adult students, influences their ability to co-create knowledge and shape the patterns through which knowledge is constructed in an online learning environment. The study was conducted during a semester-length online, graduate-level, educational leadership course in a large southern university. In one of the study's two-dimension, power parity, operationalized as differential experience levels, was measured between pairs of discussants participating in weekly case study discussions. Knowledge co-construction of student pairs, operationalized by analyzing discussion board transcripts against the five levels of the interaction analysis model (Gunawardena et al., 1997), was compared with the power parity between the pair. In the study's second dimension, students engaged in six-week long major case study analyses. Here, participants co-constructed knowledge as they collaboratively addressed the central problem with each case. Social network analysis was used to distinguish the patterns of interaction from the patterns of contribution in the process of socially co-constructing knowledge. The ability to draw distinction between these two pattern types was made possible through the use of a proposed framework or ruleset, which when used together with the interaction analysis model, enabled more direct measurement of individual student contributions to social knowledge co-construction. The ruleset addressed several methodological challenges found in prior research. It is presented and demonstrated in this study with the hope it might be adopted in future research as a companion tool for the interaction analysis model, especially in studies using social network analysis.

Problem

Meaningful social interactions and the processes through which they are internalized provide the context through which people develop higher reasoning skills (Vygotsky, 1981). While the classroom is an obvious setting for such interaction, the online learning environment presents challenges to creating meaningful interactions (Palloff & Pratt, 2003; Simonson et al., 2015).

The growing popularity of distance education has seen considerable research on and practice of instructional design which, "delineates a process to follow, through which a conception and understanding of the complex problem is derived" (Crawford, 2015, p. 414). Standing in contrast to this deterministic view of learning in which specific activities are employed to produce desired outcomes, a narrower line of inquiry informed and inspired by the works of Papert and Harel (1991), Piaget (1967), and Vygotsky (1987) constructivist concepts in identifying teaching and learning practices suitable for use in the online learning environment. Within this line of inquiry, researchers have motivated social knowledge co-construction as a valuable framework for collaborative learning among adult professionals (Gunawardena et al., 1997; Veerman & Veldhius, 2001)

Studies in this area generally explore the product and processes of social knowledge co-construction and investigate appropriate measures to describe and stratify the quality of co-constructed knowledge (Buraphadeja, 2010; Heo et al., 2010; Hou et al., 2009; Gunawardena et al., 1997, 2016; Gomez & del Rosario, 2018; Lucas & Moreira, 2010; Sing & Khine, 2006; Tan & Huang-Yao, 2008; Veerman & Veldhius, 2001). Other studies propose educational methods to promote and improve knowledge co-construction (Aviv et al., 2003; De Wever et al., 2010; Hull & Saxon, 2009; Xie et al., 2014).

One common thread in this line of inquiry is an emphasis on effective instructional activities, with little consideration of differences in knowledge and experience among students. Leading theorists (Piaget among them) suggest that the give and take required for meaningful knowledge co-construction requires equality among discussants (Baker, 1994; Conrad & Donaldson, 2004; Gunawardena et al., 1997; Stahl, 2003). Despite this assertion, empirical studies have not accounted for knowledge inequality among discussants. A constructivist view of professional knowledge would underscore the uniqueness of individual experience and by extension, would expect that this uniqueness would influence the ways through which students create meaning together as they exchange elements of their experience sets. As a discipline of study, educational leadership is highly contextual; its students interpret various theories through the lens of their personal experience and professional experience. While qualitative differences in student experience provide the context for knowledge co-construction through interaction, inequalities may develop from the quantitative differences in levels of student experience. This inequality or power imbalance could potentially inhibit the give and take required for to co-construct knowledge. The present study contributes to the constructivist literature by examining the relationship between student power parity and social knowledge co-construction among interacting pairs of students engaged in online dialogue.

In addition to power parity, a second area of concern within the empirical research is the use of social network analysis to study the patterns of interaction through which students co-construct knowledge. These studies generally focus on individual students' contributions to social knowledge co-construction in relation to the students' prominence as a participant. Measures of participation include influence, prestige, or brokerage, which correspond to three graph-theoretic constructs of social network analysis, in-degree, out-degree, and betweenness

centrality (Aviv et al., 2003; Buraphadeja, 2010; De Wever et al., 2010; Heo et al., 2010). Results of these studies have been mixed with some, such as Aviv et al. (2003) who found a positive correlation between knowledge co-construction quality and social network centrality, while others, such as Buraphadeja (2010) found no correlation between these constructs.

A possible explanation for the inconsistent findings can be seen in the way in which student contribution to knowledge co-construction is operationalized. The above studies use the five-level interaction analysis model, or IAM (Gunawardena et al., 1997), to measure the level of co-construction achieved within the transcripts of online discourse. A methodological challenge develops when researchers use the overall level of knowledge co-construction as a proxy for individual contributions. Such use favors participants in the final stages of co-construction over those who set the foundation. For example, under many schemes in the literature, a student who makes a single statement reflecting agreement of how newly co-constructed knowledge may be applied, an IAM level 5 statement, would receive five points, while the student who uncovered and framed a disagreement, an IAM level 2 statement, would receive only two points. Privileging contributions made at one level over another was never an intended use of the IAM (C. N. Gunawardena, personal communication, August 13, 2019). This study offers a proposed ruleset for measuring student contribution to social knowledge co-construction as a means of addressing these methodological challenges so that future research can measure related variables more directly.

Purpose

This study examined ways in which differences in experience levels, patterns of participation, and fulfillment of assigned roles shape the patterns and degree of social knowledge co-construction achieved by graduate student professionals enrolled in online educational

leadership course. It is often said that knowledge is power. The first part of this study looked at how differences in experiential knowledge may create power imbalances between students and how this imbalance may limit the extent to which pairs of students co-construct knowledge in asynchronous online discussions. The second part of this study shifted focus from pairs of students to the dynamics of knowledge co-construction in large group discussions. To aid in this line of inquiry, the researcher presented a framework for identifying individual contributions to knowledge constructions. This framework, used in conjunction with the interaction analysis model (Gunawardena et al., 1997) and social network analysis allowed the researcher first to explore the relationship between participation and contributions to co-construction and then observe the patterns of knowledge co-construction as students performing differentiated, assigned roles engaged in case study analyses.

Research Questions

1. What is the relationship between power parity and the level of social knowledge co-construction/negotiated meaning among paired-student threaded discussions in an online educational leadership course?
2. What relationships are seen in the patterns of student participation and the patterns of knowledge co-construction? This question is further decomposed.
    2a. How does the network prominence of students performing specialized roles (facilitator, catalyst, search engine, summarizer) relate to the overall density of the co-construction network during each phase of discussion?
    2b. What relationships are observed between student's network centrality (out-degree, in-degree, and betweenness) in the participation network and his or her contribution to knowledge co-construction?

Research Design

The nature of this study, illustrated through the research questions and the data sources through which they were explored, prescribed a mixed methods design (Teddlie & Tashakkori, 2009). Although both questions appear more quantitatively focused than qualitatively so, the constructs and their data sources are inherently mixed. First, threaded discussion board data consist of discourse, which is qualitative and also relational and frequency data, which are quantitative (Bernard & Ryan, 2010). Social networks are also inherently mixed data sources as they offer quantitative data concerning the strength and frequency of relations and qualitative data describing the meaning of those relations (Borgatti et al., 2018).

The central purpose for mixing methods in this study was complementarity, that is using both qualitative and quantitative data to build a more comprehensive picture of the phenomena under study (Bryman, 2006). Here, mixing is done to explore how power parity, a quantitative, relational construct, interacts with social knowledge co-construction, a dialectical process of discourse.

Looking across the study's phases from research question formulation to interpretation, the study can be categorized as: a fully-integrated (Creamer, 2017), convergent (Creswell & Plano-Clark, 2018), quantitatively prioritized study (Onwuegbuzie & Combs, 2011), with concurrent data collection (Creamer, 2017), drawn from an identical sample (Onwuegbuzie & Collins, 2007), transformed in the analysis phase, and interpreted, at least in part, through meta-inference (Creamer, 2017). The methods discussion in Chapter Three provides the rationale for each of these design decisions.

This study was conducted within a graduate-level, educational leadership course, taught primarily through distance education, at a large southern university. Two types of course assignments provided the research context for each of the study's two research questions.

The first consisted of a series of ten weekly discussions in which students analyzed a brief weekly case study centered around selected topics in educational leadership. The students wrote an original post addressing topical elements of the case using the language of a prescribed leadership theory. Papers were given to an anonymous partner to read. Rather than reply directly to the partner, each student was tasked to re-write the original post, taking into account different perspectives considered in the partner's paper. Once students submitted the revisions, the researcher revealed the identity of pair members and each pair was tasked to write a shared statement. These artifacts were used in conjunction with a student experience survey to address the first research question, in which power parity among pairs of students was evaluated as a predictor of the level of social knowledge construction attained through their written interaction.

The second type of course assignment was a pair of six-week long major case study analyses in which the entire class contributed solutions to address the case's central conflict, while adhering to a set of prescribed discussion board roles. This construct provided the framework for the second research question in which patterns of interaction and patterns of student contribution were examined in the process of knowledge co-construction.

Assumptions, Delimitations, and Limitations

An important assumption of this study was that the research context would provide adequate stimulus to promote social knowledge co-construction. To support this assumption, the leadership course in which this study takes place, was specifically chosen because it was recently reengineered to improve interaction quality.

In this study, the three measures of student power used in the calculation of the power parity variable were limited to self-reports, which are subject to personal distortion. The topical experience measure of power concerned a variety of educational leadership topics, each of which were relevant to one or more of the weekly case studies. The case studies related to these topics however, discussed both the topics and a specified leadership theory selected from the coursework. While the experience survey, administered at the start of term, accounted for differences in topical experience, the study did not consider power differences that could stem from different levels of course content mastery among students. Despite the lack of practical means to account for course mastery, the researcher believed that potential power differences in the theoretical aspect of the case studies could be mitigated. The students had adequate reference material at their disposal and the asynchronous nature of the discussion reduced the need to instantly recall key principles.

One limitation of the study is the small participant sample size (n = 19). Although many studies of social knowledge co-construction using social network analysis have comparable sample sizes, such as Aviv et al. (2003) (n = 18, n = 19), Gunawardena et al. (2016) (n = 15), a small sample size limits generalizability of findings and more importantly, inferential power. As second potential limitation of this study is the inability to control for personal factors impacting student participation, such as work or family issues. It is plausible that in a given week, a student could be well matched with a partner in terms of power parity but ill-equipped to provide his or her best effort due to personal stressors. In such cases, power parity, the variable of interest, could be eclipsed. Still, the effects of this condition, while limiting should be random.

Significance

This study contributed to the distance education and leadership studies literature by exploring how power parity, with respect to student knowledge and experience influences social knowledge co-construction. Further the proposed ruleset for measuring individual contributions to social knowledge co-construction provides methodological clarity for future researcher employing the interaction analysis model. Lastly, it furthers social network-based research of the online learning environment by distinguishing patterns of interaction from patterns of contribution.

Organization

The review of literature in Chapter Two provides both a theoretical grounding for this study and a roadmap, which informed the study's design. It begins with a four-frames analysis, which considers the nature of and challenges and opportunities within the online learning environment through structural, human resources, symbolic, and political lenses (Bolman & Deal, 2009). With the context provided by the four frames analysis, the review provides the theoretical grounding for social knowledge co-construction as both epistemology and pedagogy, suitable for adult online learning. This is followed by a brief introduction to social network analysis and its descriptive value when properly applied to analyzing the patterns through which students co-construct knowledge and negotiate meaning. Finally, a set of core empirical studies reveal relevant insights gained about the processes of social knowledge co-construction as they play out in the online learning environment, methods that have been developed to increase co-construction quality, and patterns of interaction found in learning environments that enable or promote co-construction. Remaining questions then motivate the present study.

Chapter Three fully describes the study's design and includes justification for major design decisions and an account of the researcher's assumptions, delimitations, and limitations. Chapter Four presents the results to the study's two research questions. Finally, Chapter Five provides the researcher's interpretations and implications, both for future research and for practice.

Chapter II: Literature Review

Higher reasoning skills develop as we internalize our social interactions (Vygotsky, 1981). The graduate student brings considerable professional experience to the classroom, enabling greater levels of student-centered learning and more importantly, a more prominent role in "student knowledge generation" (Conrad & Donaldson, 2004, p. 5).

While offering several unique benefits, such as flexible hours and improved educational access, (Palloff & Pratt, 2001; Simonsen et al, 2015), the online learning environment presents challenges to creating and sustaining meaningful interactions (Draves, 2002; Freedman et al., 2003). Empirical studies in online pedagogy have identified methods of overcoming these challenges and have been shown to promote social knowledge co-construction and negotiation of meaning. Some researchers have tried to quantify the degree to which students co-constructed new knowledge (Burapadeja, 2010; Gunawardena et al., 2016; Hull & Saxon, 2009). While others used social network analysis techniques to study the patterns of interaction associated with social knowledge co-construction (Aviv et al., 2003; Gomez & del Rosario, 2018). Recently, researchers have considered how power differences factor into social knowledge construction contexts but not specifically in student-to-student interactions (Owusu-Agyeman & Fourie-Malherbe, 2019; Thembinkosi, 2019).

Though numerous studies quantified and measured social knowledge co-construction, they lacked an agreed upon framework for extracting and quantifying individual contributions to the co-construction process. This has resulted in a wide variety of conflicting assertions about the patterns of interaction associated with knowledge co-construction and the individual characteristics of participation of contributing students.

Organization

This literature review provides a synthesis of research concerning social knowledge construction in online learning. It begins with a four frames analysis to characterize the online learning environment through structural, human resources, symbolic, and political lenses (Bolman & Deal, 2010). Next, a review of relevant constructs and models concerning social knowledge co-construction and negotiated meaning, with an emphasis on the online learning context, describes efforts to frame, measure, and promote the co-construction of knowledge. Then, a review of social network analysis research in this domain illustrates the use of graph-theoretic tools for analyzing online student-to-student interactions. Finally, a synthesis of relevant empirical research highlights the insights gained and questions that remain unanswered concerning the social co-construction of knowledge in online graduate learning contexts.

Four questions guided this literature review, which in turn identified relevant gaps in the empirical and methodological literature. Knowledge gained in addressing these four questions informed the nature of this study and its research questions.

1. How do the characteristics of the online learning environment shape the processes through which students co-create new knowledge?
2. What are the ways in which social knowledge co-construction have been conceptualized, measured, and promoted in online learning contexts?
3. How has social network analysis been used as a tool to interpret the patterns of interaction associated with social learning in online environments?
4. What lessons have the empirical research of online social knowledge co-construction processes and resultant patterns of interaction provided and what conceptual or methodological barriers limit our understanding?

Conceptual Framework

Social knowledge co-construction results from the dialectic interaction among two or more individuals (Hull & Saxon, 2009). In learning environments where the students' previous experiences combine with highly contextual subject matter, such as in the study of educational leadership, social knowledge co-construction pedagogy presents a unique opportunity for students to contribute to one another's learning.

Although interaction in pairs where one member has more extensive experience can aid human development (Whiteside et al., 2017), theorists such as Piaget, as cited in Conrad and Donaldson (2004), Baker (1994) and Gunawardena et al. (1997) have asserted or at least, implied that knowledge co-construction and negotiated meaning are most fruitful when peers have parity in knowledge and experience. Gunawardena et al. (1997) developed the interaction analysis model to observe and measure knowledge co-construction in a context in which "the participants could be described as a group of professionals of roughly equal stature coming together to contribute their knowledge, negotiate meaning, and come to an understanding about an important issue…" (p. 402).

Knowledge Co-construction Metaphor

Consider a soft-serve ice cream machine. You can draw from one side and have vanilla, the other and have chocolate. If you draw the two together in equal measure, you get chocolate-vanilla twist, a distinct flavor combination. This is not the same as a half cup of vanilla with a half cup of chocolate on top so that you taste one flavor, then the other. The twist is two flavors coming together in partnership to create something that could not be created alone. This is the product of the construction. The process of construction depends on learning environment, which is akin to the ice cream shop. It is the place where the flavors come together. Further, the

design of the learning activities is like the soft-serve machine; it creates the context for coming together. Unlike ice cream however, individuals engaged in knowledge co-construction retain their agency through the process of coming together, which like the product itself, is the result of continuous negotiation.

Understanding how various pedagogical methods can be used to promote social knowledge co-construction can give online instructors valuable insights, potentially informing both course design and guiding instructor behavior in moderating online discussions. Additionally, insights of non-instructional factors, such as variability of expertise among students may allow for finer tuning of instructional activity. Reliable processes for tracing groups processes of knowledge co-construction may inform our understanding of the patterns of successful meaning making among adult learners.

Graphical Representation of Conceptual Framework

Centered around the interaction analysis model (Gunawardena et al., 1997) the conceptual framework guiding the current study is depicted graphically in Figure 1.

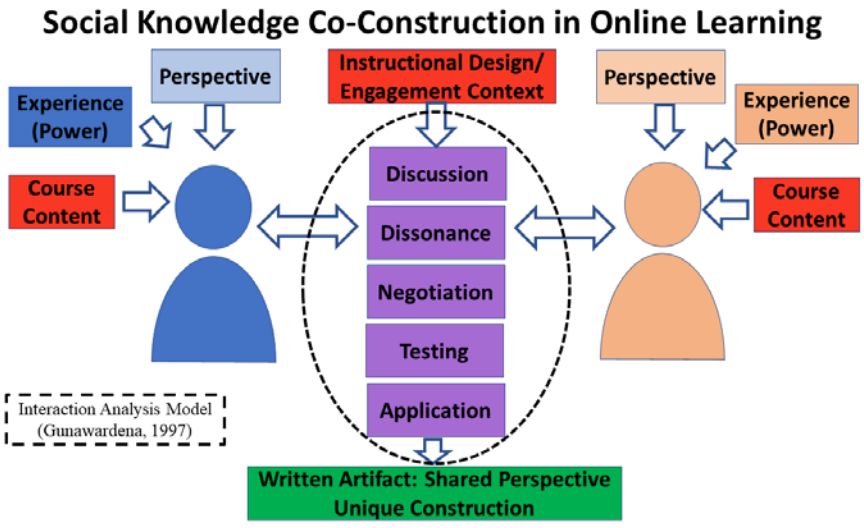

Figure 1. Conceptual framework – Social Knowledge Co-Construction in Online Learning (adapted from Gunawardena et al.'s [1997] Interaction Analysis Model.

This framework illustrates key elements of social knowledge co-construction. Graduate students enter the learning environment informed by personal and professional experience. As they engage course content, whether in the form of assigned reading, video lectures, interactive media, or any combination thereof, the content, often taking the form of theory, mixes with their lived experience to shape their perspective. Then, through a thoughtfully designed instructional exercise, they discuss professional implications of the course content. If properly designed to promote reflexivity and critical discussion, the students will begin the process of co-constructing new knowledge, which takes place through the five phases of the interaction analysis model (Gunawardena et al., 1997). In the model, sources of cognitive dissonance can be reconciled through negotiation. As with any negotiation, relative power between the parties can shape the negotiating process. Ideas emerging from this negotiation phase take the form of new or nuanced interpretations or meaning, which can be validated and applied. The result is an artifact, a unique co-construction reflecting a shared perspective.

Value and Implications for Practice

The value of this admittedly long and potentially taxing process is multifaceted. First, by attending to, rather than avoiding, differences in interpretations, professionals combine critical thinking, demonstrated through the process of communicating dissonance, with creative thinking, observed in the proposal and negotiation of new constructions. Next, the knowledge co-construction itself represents a higher level of quality than the original conceptions of either party. Why? Because the original conceptions have evolved to address valid challenges posed by one or more peer professionals. Finally, changed perspectives are evidence of a willingness to think differently. Given the ubiquitous calls for change across all levels of education, engaging

in patterns of discourse that promote thinking differently may develop dispositions to embrace, rather than resist change.

Four Frames Analysis of the Online Learning Environment

The following discussion examines the online graduate learning environment and explores the constructivist ideas of social knowledge co-construction and negotiated meaning using the four frames analysis developed by Bolman and Deal (2010). Analysis of the structural, human resources, symbolic, and political frames, provides a set of overlapping contextual lenses which describes not only phenomena, but identifies the relationships among the many variables found in complex social settings.

Structural Frame

Structurally, the online environment is simple to conceive. It consists primarily of the instructor, the students, the network, and the course management system (Simonsen et al., 2015). Perhaps more consequential to learning than the physical structure of the online learning environment is way in which knowledge is represented and ideas are exchanged.

Structure of the Environment and Representations of Knowledge. Discussion boards can be described as spaces where students write their assigned posts. However, as Wenting (2017) notes, online interaction is about student-to student dialogue rather than message posts. When we conceive the board in terms of the latter, we set the expectation for checking a required box. If the emphasize the former, we ask instead for a more authentic expression of self. Understanding how to structure discussion boards that "engage students in meaningful discourse is essential to improving distance education" (Ringler et al., 2015, p. 16). A fundamental limitation of the discussion board is its inadequacy to fully represent what an individual knows or believes.

Eisner (1988) adopts the Vygotskian idea that knowledge stems from experience. What is written, spoken, or otherwise expressed is a simplified representation of knowledge. The form of representation imposes limitations so that only a portion of what is known is revealed (Wilson, 1993). By socializing our knowledge, or taking Wilson in to account our knowledge representation, variations in form or schema reveal asymmetries, both between what we know and how we express it and between how any two individuals know something. These important differences come to light only when we participate in dialogue. When students engage in meaningful dialogue, they can negotiate new meaning for familiar concepts and/or construct new knowledge entirely.

In more behaviorist-oriented learning, instruction can be seen in terms of information and instruction chosen to achieve specific learning outcomes. Constructivists would argue that learning is more individualized and contextual than any a priori learning outcome can state, Therefore, the constructivist would envision instruction designed to bring about a series of experiences, interactions or environments intended to help all participants make meaning from experience. When instruction is thought of in this way, "it becomes more systemic in that it is highly sensitive to the conditions of use" (Wilson, 1993, p. 1141). As Schon (1987) suggests, the instructor creates instances of practice which are influenced by experience, perceptions, and values. In this way, teachers can be just as much of a participant in knowledge construction as the students.

Roles and Responsibilities. If the basic principle of adult learning is to be taken at face value, namely that adult learners are self-directed (Knowles, 1980), then roles for teachers and adult students in online courses would be straightforward. Learners would simply teach themselves and instructors would facilitate, primarily in an administrative capacity. However, as

Holmes and Abington-Cooper (2000) advocate, it is more constructive to look at adult learners as being on a continuum between dependence and autonomy. Their place on the spectrum is governed by several factors including their comfort level with rigorous online engagement. The online instructor must remain cognizant of her students' needs in this regard as she fulfills her roles as evaluator, moderator, catalyst, and guide.

The role of evaluator in online learning serves the same purpose as in traditional learning environments, to assess student performance both formatively and summatively (Garrison & Vaughn, 2008). From a knowledge constructive perspective, instructors need to look closely and frequently at who is making contributions to learning products and who is asking important questions during group discussions (Simonsen et al., 2015).

Knowledge co-construction requires effort, but until students become accustom to doing the heavy mental lifting required, the instructor needs to embrace a catalyst role. Palloff and Pratt (2001) argue that getting students to reflect critically and construct new knowledge is an instructor's primary role in online discussions. Ringler et al. (2017) echo this sentiment by stating that "the role of the instructor is critical to keeping students motivated to participate in ongoing discussions" (p. 17). The tools of collaboration must be sharpened for them to be effective. And while "resistance to collaboration can be daunting, ultimately these valuable work skills will be a practical addition to any student's abilities" (Simonsen et al., 2015, p. 243). Many students lack cooperative learning experience and may need a push to help them break out of the "competitive learning mode" to which they are accustomed (Conrad & Donaldson, 2004, p. 8).

In addition to motivation, online learners need clear and continued guidance. Instructors must communicate their expectations for discussion board participation (Garrison & Vaughn,

2008). This should be done up front through the syllabus (Simonsen et al., 2015) and in response to initial efforts “monitoring responses an providing additional support when needed” (Ringler et al., 2015, p. 16).

Perhaps the most challenging of the instructor’s role is that of moderator. The first job as moderator is “to model and thread the discourse” (Garrison & Vaughn, 2008, p. 95). This is related to setting expectations, but it goes further. By participating in early discussions, the instructor can model desired behavior. Caution needs to be taken in this department. When there is too little moderation, threads tend to veer off topic; too much can prevent students for taking responsibility for their own learning (Garrison & Vaughn, 2008). When instructor find themselves answering content-related questions in threads, discussions tend to stop (Ringler et al., 2015).

While the teacher performs each of these roles, the students assume their roles, at least initially, under the direction of the teacher. In general, all students have the responsibility to fulfill the participation requirements as usually stated in the syllabus. As peers engage one another they “participate in the learning situation and thus gain the most knowledge from being a member of an online community” (Conrad & Donaldson, 2004, p. 7). However, as students take responsibility for their learning, their roles can become more dynamic. Instructional strategies should enable a “shift in student roles” to develop self-direction (Conrad & Donaldson, 2004, p. 8). In constructivist learning models, learners “often assume the role of teachers” (Wilson, 1993, p. 1144). “As students gain experience, they should be given responsibility to moderate a discussion [thread]” (Garrison & Vaughn, 2008, p. 95). Researchers such as Veerman & Veldhius-Diermanse, (2001), Strom and Strom (2002), Schellens & Valcke (2007), de Wever et

al. (2008; 2010), and Wenting (2017), have developed individualized student roles to promote deeper learning, authentic experiences, and knowledge co-construction.

In their CLEAR model, Strom and Strom (2002) prescribe up to twelve unique student discussion board roles, which can be combined if needed and rotated among students throughout the course. Wenting (2017) developed and tested a simpler model in which she assigns students to four rotational discussion board roles: "starter, moderator, participant, and wrapper" (p. 87). Task interdependency is vital to encouraging meaningful collaboration rather than simply promoting an equitable division of labor (Aviv et al., 2003; Wenting, 2017). The starter reads ahead in the course materials and develops discussion questions designed to foster debate. The participants engage in discussion while the moderator keeps the discussion on track. The wrapper then publishes the discussion summary and synthesis. In her study, Wenting (2017) found that students perceived a strong sense of community and engaged in knowledge co-construction. She also conceded that "many students found the process difficult" and recommends its use periodically rather than throughout the entire course (p. 101).

Human Resources Frame

As Draves (2003) so eloquently states, "The heart and soul of your online course is not content, but interaction" (p. 103). This sentiment, when applied to constructivist teaching approaches, means that "it is the relationships and interactions among people through which knowledge is primarily generated" (Palloff & Pratt, 1999, p. 15). While the structural frame looked at the mechanisms through which knowledge co-construction can be achieved, analysis of the human resources frame brings into focus the centrality of the human element in the online environment.

Freedman et al. (2003) list five barriers to successful online learning. Three of these lie within the human resources frame: "social distance" (p. 159), the perceived separation from peers or from the instructor; vulnerability or *fear*, which can result when feedback, critique, or other communications are perceived as hostile; and *rigidity*, a perception that the learning environment or instructor rules are too inflexible (p. 159). These inter-related barriers are explored here with examples from the literature and with potential remedies.

Social Distance. As Freedman et al. (2003) describe, social distance is an isolating condition in which students perceive considerable distance between themselves and their instructor or between themselves or each other. This distance is measured in terms of the difference between students' sense of credibility, capability, or readiness to engage meaningfully with the course and their perceptions of these qualities in their peers or in the instructor. These perceptions may result from a lack of skills and experience or they may be a matter of expectation and confidence. In either case, the literature offers multiple remedies.

The instructor can be most effective in this regard at the outset, while the class is in its formative stage (Simonsen et al., 2015). For example, during introductory or icebreaking activities, the instructor can drive home the point about how much the unique inputs of students are valued and needed. The instructor's excitement about the caliber of students, as evidenced by their backgrounds, can promote a sense of purpose for students as they prepare to engage in online discussions (Draves, 2002). Some learners, especially those with less experience in online learning may feel isolated and may be hesitant to engage with other learners or with online course materials (Freemen at al., 2003). To address this concern, the instructor can emphasize the purpose of a constructivist learning environment as means to enhance the knowledge of both students and instructors alike (Wake & Bunn, 2015). By positioning themselves as a learner

within their own course, this constructivist principle could arguably reduce social distance. Further, as Wake and Bunn (2015) advise, “In a properly designed constructivist learning environment, students and teachers feel a sense of shared responsibility for creating a learning community that results in an increased level of satisfaction with the course” (p. 41). This sense of shared purpose reduces social distance by putting the class and the instructor on common ground.

When differences in experience and skills seem too vast to overcome, Klein (2003) suggests a more radical approach: anonymizing discussion board participation. While course management systems may vary in their ability to allow anonymous posting, the practice has been proposed to reduce student inhibition to engage openly by removing names. This was proposed not only to remove any stigma from a lack of experience or credentials, but also to encourage more even participation across gender and cultural lines (Klein, 2003).

As the course progresses, it is important to maintain efforts to reduce social distance. “When students perceive a lack of instructor feedback, feelings of student isolation can result” (Freedman et al., 2003, p. 159). As some students engage in discussion forums or submit other graded work, they feel a need for validation. A brief comment, even one made ahead of formal grading, can be an opportunity to acknowledge a student’s efforts and promote greater connection (Freedman et al., 2003).

While the remedies discussed so far address perception, some social distance issues can result from a lack of skills. Constructivist methods require students to engage substantively in discussions involving both theory and practice. “The dialogical interaction between individuals,” especially when one may have more extensive knowledge on a particular topic, “aids in human development” (Charbonneau-Gowdy, 2018, p. 57). Further, “providing theory-based knowledge

and well-argued comments is a skill that can be learned and should be taught" (Vuopala et al., 2016, p. 35). In many online courses, students often lack "the opportunities necessary for building the kinds of self-directed and empowered learner identities that research has shown lead to optimal sustained learning" (Charbonneau-Gowdy, 2018, p. 59). Some students may benefit from resources and strategies designed to help them learn to read and write more critically (Wake & Bunn, 2015). Another possible approach is for the instructor to provide exemplars of discussion threads and discuss these in the context of the course rubric. Other skills development resources can be provided in the form of links to external sources.

Fear. In online learning environments, fear can result from the perception of hostility or a reluctance to embrace the unknown. The instructor is responsible for minimizing the former and can provide assistance in mitigating the latter. Keeping instructor communication positive is important in reducing students fears regardless of the cause. Students need encouragement. We often think we praise more than we do; when in doubt, it is better to provide more encouragement than less (Draves, 2003). As students put themselves out there through their analyses, it is more important that instructors' comments encourage further discussion than offer critique. Further, when offering critique, it is better to be understated than overstated as the instructor's perceived authority already amplifies criticism (Draves, 2003).

Learning from the experiences of others can be completely new for some. Wake and Bunn (2015) believe that "learners who were raised in the high stakes testing environments resulting from NCLB may have become accustomed to more didactic methods and can encounter difficulty in adapting to new teaching and learning methods" (p. 41). Marken and Dickinson (2013) add "students in online courses may resist group work more than face to face classes because they grow accustomed to the independent and asynchronous nature of online courses (p.

304). As a result, of this condition, Wake and Bunn (2015) note that many students are uncomfortable interacting online. They may avoid any interaction that is not explicitly required as part of a course requirement and engage minimally in graded situations (Dobozy, 2009). To provide support for this concern, Draves (2002) recommends both intrinsic and extrinsic sources of motivation. Providing a detailed rubric that incentivizes (via grading) more thorough participation answers the extrinsic, while making clear connections between the assigned activity and the desired learning outcomes add a source of intrinsic motivation (Draves, 2002).

Creating a shared sense of purpose, as discussed previously, can also counter the effects of fears. In study on building an online community of practice, Marken and Dickinson (2013) emphasized the value in creating unique roles for students and concluded that students understood that "when peers fail to perform assigned roles, that learning objectives are put at risk" (p. 304). Finally, self and peer evaluation may be useful both in creating a feeling of agency within learners and in promoting a greater sense of mission or purpose in carrying out the learning tasks for which they are responsible (Vuapola et al., 2016).

Rigidity. The final human resources barrier to forming a successful constructivist online learning experience is rigidity or the extent to which the student perceives the learning environment as fixed, and the students' choice constrained. In face-to-face courses, teachers can cue in on facial expressions, tone of voice, and other signals that occur in the moment as indicators of the student's level of interest or understanding. If teachers are to detect these indicators in online learning, they must learn how to read student writing in the same way (Draves, 2002). By learning to look for cues of stress, confusion, or other inhibiting factors, instructors can respond appropriately. This could take the form of additional remediation or flexibility in deadlines. Even full-time students generally have competing demands of employers

and families. The extra work required for meaningful, active participation needs be balanced against the importance of the educational objective sought in the participation (Manning & Smith, 2018). Because meaningful exchanges in online discussion forums can be both time-consuming and mentally taxing, it is important that such activities be assigned efficiently with respect to desired learning outcomes.

Symbolic Frame

In the social constructivist, online learning environment, the symbolic frame is where meaning is found. The digital domain has inherent structural characteristics, but the meaning one makes of for the environment is entirely dependent on the instruction, the knowledge constructed, and the community in which knowledge is constructed.

The Value of the Construction. Course content can be thought of as the clay through which knowledge is constructed (Weigel, 2002). In a social constructivist learning environment, peer interaction and collaboration are what allow the clay to take unique shape (Conrad & Donaldson, 2004). The construction can be thought of as both the product and the process under which socially constructed knowledge is built. "Most educators believe that to get the most out of a learning experience, students must engage with course content and contribute to the class discourse" (Garrison & Vaughn, 2008, p. 129). But social knowledge co-construction has meaning beyond the course takeaways. As the processes through which meaning is negotiated become internalized within individuals, a class culture develops (Hull & Saxon, 2009). This culture contains the "tools of development" which can vary in their effectiveness depending on the extent to which they are acknowledged among the group members (Hull & Saxon, 2009, p. 626). Among the most important of these tools is language or more specifically, the socially negotiated meaning of terms and concepts used by members (Powell & Kalina, 2009).

When the language of discussion is socially negotiated by a diverse group, constructions made from this unique, common language are themselves unique. The value and meaning of such constructions can become deeply personal (Powell & Kalina, 2009). This personal connection creates a permanent sense of ownership in the construction. In a sense, the construction contains an embodiment of the self far more personal than the demonstration of mastery.

The Meaning of Community. While the construction reflects the individual's unique contribution, it also reflects the uniqueness of the community who created it. In the social constructivist learning environment, the students have a responsibility to one another. "The online environment requires that participants be prompted to take their instructional cues from each other within the frame set by the assignment" (Hull & Saxon, 2009, p. 626). But the acceptance of cues from peers as an authentic call for self-expression, requires that students perceive one another as authentic beings. In purely online environments this means constructing and projecting an authentic representation of the self through the digital domain. Hybrid learning generally has the advantage of beginning this process with the aid of face-to-face interactions.

The ability to project an authentic representation of the self into an online "community of practice" is known as social presence (Rourke. et al., 2001, p. 50). Social presence theory defines three behaviors are defined which are said to build social presence. These are *affective* behaviors, which express attitudes, values, and beliefs; *cohesive* behaviors, which promote group identity, and *interactive* behaviors, which indicate support among students (Swan 2002). When all three of these behaviors are prevalent in an online social constructivist learning environment, one can infer an authentic community. The meaning this community holds for students is not so

distinct from the social knowledge constructed therein. It represents an extension of the self because it contains the ingredients of the self. It is also a place where the individual, or at least the individual's perspective, is transformed by the unique contributions of peers.

Political Frame

The political frame provides a most unique way to study the social dynamics of the online social constructivist learning environment. In their discussion of the political frame concerning educational change, Bolman and Deal (2010) describe the utilitarian way in which relationships and alliances are leveraged to manage power and improve one's negotiating leverage. By contrast, an analysis of the online social constructivist learning environment shows that while it is governed in part by power relationships, it appears to embody a more egalitarian power dynamic.

In his compendium of leadership theory, Northouse (2019) cites the work of French and Raven (1962), who offer a typology of power types defined in a leadership context. While each type of power represents a form of influence, they are differentiated by the manner in which the power is conferred and wielded. Referent power stems from a leader's likability and the extent to which followers identify with the leader; expert power exists to the degree people perceive the leader as knowledgeable on relevant subject matter; legitimate power requires a source of authority, such as the power held by a judge to render a decision; a leader who can offer incentives has reward power; similar, those who can conditionally punish have coercive power; finally, those who maintain a close hold on valuable intelligence have information power (Northouse, 2019). Given the inherent connection between education and leadership, Northouse's description has relevance for the teaching and learning environment.

Power and the Student-Teacher Relationship. When compared to a more objectivist setting, such as an undergraduate calculus course, a graduate leadership course taught in the constructivist tradition has more of a power sharing dynamic. The teacher would have the same reward, coercive, and legitimate power in either course because he or she can offer extra credit, deduct points for late assignments, and enforce university plagiarism policy. On the other hand, the nature of expert, referent, and information power sources are quite different between each course. In the calculus course, the student seeks to learn the subject's concrete language and grammar; the instructor has it – the student needs it. By contrast, in the graduate leadership course, while the instructor is still an expert, the student has unique, relevant experiences of practice that lead to interpretive differences in how course theory is perceived. These perceptions are shaped and meaning subtly changed through engagement with the curriculum and interaction with the instructor. The student-teacher relationship here is one of mutual influence and therefore, the pair shares expert power. Because sharing of personal experience requires a degree of relatability, students, and teachers each require referent power to facilitate the exchange.

Legitimate power, though held exclusively by the teacher, has limits under a constructivist pedagogy. For example, the instructor can use legitimate power to direct students to work in groups, but without ensuring an environment that promotes trust and respect, collaborative learning should not be expected. To create this environment most authentically, the instructor should yield power to allow the students to build and project their online social identity and personalize their learning (Chih-Hsiung, 2017).

In order to create new and compelling meaning in social constructivist environments, students must be able to exchange elements of their selves. Online social presence is the ability

of people to project a representation of themselves so that they can be perceived as "real people" (Garrison et al., 2000). If instructors understand the power they possess in shaping the various forums in which their students interact, they can be more deliberate in deciding the degree of agency they are willing to concede. If the instructor uses reward or coercive power as a catalyst to spur students to communicate and build their online presence, he or she can empower them in choosing their means of self-expression. Once students take ownership of the means of expression, they can begin to share authentic representations of their selves with their peers.

Power and the Student-to-Student Relationship. In the online social constructivist learning environment, negotiation of meaning is the process where political power dynamics are most readily observed. As students engage one another in online discussion and debate, they bring their experiences and opinions with them. As they draw from their experience, they apply course concepts in ways reflective of this experience. Terms and definitions from the course materials are given proposed shape and context. However, when peers review these new propositions of their classmates, they may experience dissonance. As the peers' own experience has shaped their interpretation of course concepts, when they come across an interpretation incongruent with their own, the stage is set for a negotiation of meaning (Gunawardena et al., 1997).

Power is the central factor in negotiation and authors of negotiation strategy, such as the Harvard Program on Negotiation, instruct their adherents to "make the most of your potential power" (Fisher et al., 1993, p. 12). With these sources of power understood, a look at a common negotiation model can frame the context in which this power can be applied. The negotiation style preference chart and Trust, Information, Power, Options (TIPO) model (Eisen, 2011) are commonly used in international relations contexts. The five negotiating strategies are evade,

comply, insist, cooperate, and settle. The logical selection of preference for a given situation is a function of task importance and relationship value. It is also informed by relative power differences. When one meets an *other* with significantly more power, one can choose to comply, if it is important to maintain the relationship, or evade, if the relationship is not of concern. In a social knowledge co-construction context, neither of these behaviors result in new knowledge.

If debating a point with a peer who reveals unmatched expert power on the subject, a comply strategy is most reasonable. That is, further argument is futile. But this capitulation does not produce a new co-construction. Rather, one party's perspective may be altered while the other's remains unchanged. This represents a diffusion of knowledge, but not a new co-construction.

As the evade strategy avoids engagement, it maintains the status quo. The insist strategy is the precursor or impetus of one's evasion or compliance, and so it too preserves the status quo. Cooperate and settle strategies change the status quo. When negotiating parties cooperate, they show their cards and work together with the explicit goal of an outcome that is more mutually satisfactory than the status quo (Eisen, 2010). In a settle strategy, each party accepts a perceived fair share of unfavorable conditions in exchange for preserving some element of value. Either of these strategies result in change and both require a power parity among participants.

But unlike the negotiation of favorable outcomes, in which resources are individually held and may be exchanged in kind such that "one party's gain is at the direct expense of the other party" (Neale & Bazerman, 1991, p. 21), negotiation in the process knowledge co-construction produces shared gain in the form of more nuanced and validated knowledge. To explore this difference, a closer look at the referent and expert types of student power is needed.

As mentioned earlier, Northouse (2019) describes referent power as that which results from a person's likability. In the online environment, likability also requires some perception of authenticity developed through social presence (Garrison et al., 2000). Referent power is a function of the perception of an online personality's likeability and authenticity. A person perceived as either aloof or phony will find fewer peers interested in engagement. Likability may open the door to discussion, but subject matter credibility, that is expert power, is needed to challenge the experience-informed beliefs of one's peers.

A principal from a remote county opining on the challenges facing rural schools, would command considerable expert power on that subject. Likewise, teachers in high-poverty schools understand the challenges their students face in ways unmatched by those who teach middle-class students in well-funded districts.

Negotiated meaning and knowledge co-construction require a give and take (Stahl, 2003). Unlike international relations or commerce where participants hope for a favorable power asymmetry, the cooperate and settle strategies that can lead to knowledge co-construction have an expectation of power parity (Eisen, 2010).

Social Knowledge Co-Construction and Negotiated Meaning

While constructivist pedagogy figures prominently in the current teaching literature, it is important to understand the epistemological assumptions behind its use. Further, as calls continue to be made to expand its use across a wide variety of learning contexts, specific proposals could benefit, in terms of rigor, by clearly grounding their assumptions to one or more of the theoretical camps within the constructivist paradigm. The following section attempts to motivate social knowledge co-construction and negotiated meaning by defining it in its relationship to its parent theories including Piaget's cognitive constructivism (1967), Vygotsky's

social constructivism (1986), Papert and Harel's constructionism (1991), and relevant negotiated meaning theory from Baker (1994) and Stahl (2003).

In exploring the origins of constructivist epistemology, Ernst von Glasersfeld (1989) uncovered an unknown early 18th century manuscript by an Italian philosopher, Giambattista Vico, who declared, "God is the artificer of nature, man the god of artifacts" (p. 124). Vico's assertion, developed more completely, was that to truly know something requires knowledge of what it consists and of how to create it (von Glassersfeld, 1989). Humans then are merely "epistemic agents" whose knowledge consists of "conceptual structures" built from our individual ranges of experiences within our learned traditions of language and thought (von Glassersfeld, 1989, p.125). Piaget's experiments, two and a half centuries later, reached a compatible conclusion (von Glassersfeld,1989).

Students' views do not simply change because someone shows them a more representative theory, but because of the interaction of lived experience with a set of complex internal processes (Ackermann, 2001). According to Piaget (1967), individuals construct mental representations called schemas, which maintain an equilibrium with what is experienced. New information can be absorbed into an existing schema through the process of assimilation, but major changes or "perturbations" (von Glassersfeld, 1989, p. 126), which contradict the schema so that it is no longer "viable" (von Glassersfeld, 1989, p. 127), require a more disruptive process called accommodation to restore equilibrium (Piaget, 1967).

Powell and Kalina (2009) distinguish Piaget's cognitive constructivism from Vygotsky's (1986) social constructivism arguing the former occurs within the mind of the individual while the latter takes place among students or between teacher and student. A further distinction is offered by noting that in Piaget's theory, "thinking precedes language" while according to

Vygotsky, “language precedes thinking” (Powell & Kalina, 2009, p. 241). Yet another distinction is made by Ackermann (2001) who states that Piaget’s constructivism is “grounded in action” while Vygotsky’s socio-constructivism is “mediated through language” (p. 442).

However, these simplifications break down when we move the discussion from the concreteness of the sensory-motor arena to that of “reflective abstraction” (von Glaserfeld, 1989, p. 127). When learning to expect physical results from deliberate action, such as the bounce expected when dropping a rubber ball on a hard surface, we are developing schemas of the sensory-motor sort. When parents attempt to teach a child a new word by pointing at an object and stating the word, this is a representation of reflective abstraction, a realm of learning that very nearly resembles concept formation, a key component of Vygotsky’s socially-mediated learning (Clara, 2017). But as Clara (2017) notes the theories diverge with the notion of spontaneous and non-spontaneous meaning.

In Vygotsky’s notion of instruction for development a teacher engages a student in discussion of a concept that the student has only partially developed. To the adult, the fully developed concept has spontaneous meaning, that is the word fully represents the abstract concept with which it is associated (Vygotsky, 1987). The child imitates the adult in the use of the word, the meaning of which is understood non-spontaneously, that is the child gives the word the best meaning he or she can, subject to the availability of relevant concepts for which the child has spontaneous meaning (Clara, 2017). Through feedback on correct and incorrect use, that is through social mediation, the student develops spontaneous meaning (Towsey & Macdonald, 2009). The gulf between spontaneous and non-spontaneous meaning is best known by the term *zone of proximal development* or ZPD (Vygotsky, 1987, p. 210). But this idea that the adult is in possession of the true meaning of words while the child is not, appears difficult to apply to adult

constructivist learning. By contrast, Piaget's cycle of assimilation and accommodation continue throughout adulthood (von Glasersfeld, 1989). Nonetheless, research in social knowledge co-construction and negotiated meaning include a mix of Piagetian and Vygotskian frameworks (Aviv et al., 2003; Baker, 1994; Gunawardena et al., 1997; Hull & Saxon, 2009; Stahl, 2003; Veerman & Veldhuis-Diermanse, 2001).

Extending Piaget's (1972) theories to adult learning, Rigel (1973) added a final stage of development in which adult schemas could and should remain in some state of disequilibrium as an acknowledgement of the complexities of phenomena and the Hegelian notion that any concept exists "within a multitude of contradictory relations" (p. 7). Acknowledging this plausible idea, one need not abandon Piaget's schemas entirely. If we allow the idea that adults are still subject to triggering events that challenge how we interpret the world, and we navigate these challenges through the process of negotiation and co-construction, the schematic change need not produce equilibrium, but only provide a more navigable path through the trigger's consequences. With this allowance, social knowledge co-construction maintains compatibility with Piagetian constructivism.

Distinguishing Constructivism from Constructionism. Constructionism and constructivism each describe learning as "building knowledge structures" but constructionism adds the idea these constructions take the form of a "public entity," which can vary in concreteness from a "sandcastle to a theory of the universe" (Papert & Harel, 1991). Papert and Harel (1991) believe that knowledge is tied to context and can be "shaped" by the way it is applied (p. 440). This contextual and pragmatic grounding of knowledge is compatible with situated learning theory (Lave & Wenger, 1991).

Papert and Harel's (1991) constructionism was motivated in part by considering how students' art projects produced artifacts that parents or teachers might fight over, each eager to possess a unique, tangible representation of a child's skill mastery and expression. He observed that few would feel the same way about a math assignment, for the latter only demonstrated the child could learn the skills he or she was taught. An "A" grade math quiz would look remarkably similar and de-personalized no matter which student produced it. He reflected on how basic art skills could be learned through the act of constructing and considered that there was no reason that math could be learned in the same manner. It should not be surprising to learn that the MIT scientist became one of the early champions of Lego robotics in education. Papert and Harel understood that students motivated by the desire to animate their creations in accordance with their creative visions, would learn the fundamental math and physics skills needed to achieve their goals.

A constructionist view in the online discussion board might see two or more professionals, combining theoretical content and personal experience to address a practical case study problem representative of their professional environment. The resultant artifact would not be a Lego choreography, but a unique, socially negotiated co-construction of analysis and action.

Negotiation of Meaning

Broadly conceived, negotiation of meaning refers to the processes through which individuals make sense of their world. Two types of negotiation relevant to adult learning are (a) the process of making sense of text and/or navigating how to conform ones ideas to expected conventions (Flower, 1994); and (b) an interactive social process through which two or more persons trade concessions and assertions in pursuit of agreement on the meaning of abstract concepts (Baker, 1994; Stahl, 2003).

Negotiated Meaning Defined. Meaning making is a "critical and creative process" resulting in a unique construction (Flower, 1994, p. 45). Stahl (2003) defines *knowledge negotiation* as "a nuanced give and take, whose aim is to reach a solution that did not already exist in any participant's opinion, but that is ultimately made acceptable to all" (p. 5). Negotiation events can be distinguished by "negotia", that is, the nature of what is being negotiated (Baker, 1994, p. 206). Two examples offered are goals and solutions. Baker (1994) notes that while negotiations are often characterized as a conflict to be resolved, he posits conflic*t* as a condition which may arise at any time during negotiation. To resolve conflict, "terms are clarified, alternative related statements are compared, linguistic expressions are refined, warrants are scrutinized" (Stahl, 2003, p. 5). When completing a writing assignment, such as a discussion board post, the text is the only artifact the reader has. The writer's "strategic process of meaning making, including efforts, intentions, assumptions, and dilemmas," remain hidden (Flower, 1994, p. 48). When writers collaborate, their negotiation process can illuminate these forces to one another, at least to some extent, creating at least a partial, mutual understanding (Flower, 1994). Thus, we can think of knowledge negotiation as a conflict-laden process of exchange and compromise in the pursuit of a shared understanding.

How Meaning is Shared Among Participants. Flower (1994) describes meaning as made in a network where the nodes are words or concepts and the links between them become activated when thinking or writing about larger ideas that draw on these nodes. This metaphor "offers a powerful and precise way to talk about meaning as a fluid and interactional construction, not limited to the prepositional or even verbal representations of text" (Flower, 1994, p. 40). Negotiation between two or more persons requires a symmetrical interface between these networks of meaning through which a "collaborative goal" is established and a "refinement

strategy" is agreed upon (Baker, 1994, p. 207). When writing, the writer's "network of intention" is shaped in part by purposes provided by the "culture, context, assigned task, and convention of discourse" which bind intention by "innumerable constraints, unrecognized givens, and shared desires" (Baker, 1994, p. 45). These factors, remain partially unique and partially shared among discussants, interact through collaboration in such a way that "personal perspectives contributed by the participants" merge "into a group perspective," which is "definitive of the [shared] discourse" (Stahl, 2003, p. 3).

Promoting Negotiation of Meaning in the Learning Environment. While Papert and Harel's (1991) constructionism is domain agnostic, Michael Baker (1994), a pioneer in designing learning environments using artificial intelligence, suggests that some disciplines are more favorable for knowledge negotiation. Citing previous work by Moyse and Elsom-Cook, Baker offers eight propositions concerning such domains. Key among these are that there is no "privileged or correct viewpoint on knowledge", representations of knowledge should be co-constructed," and learning environments require "mechanisms" supportive of negotiation (p. 209). Stahl (2003) supports these claims noting that in the online learning environment, it "is necessary to design an application mechanism for the support of knowledge negotiation (p. 5). Stahl (2002) proposes five requirements of the learning environment. First, the object of negotiation (Baker, 1994) should be a "proposal of constructions as a product of shared knowledge" (Stahl, 2003, p. 63). Discussions follow during which writers do more than state claims; they create representations of personal meaning and social action (Flower, 1994). Through this process, "multiple starting positions interact and evolve through a series of changing alternatives until a single consensus position is reached through discourse. The discussion is a subtle political interaction that brings many aspects of power, motivation and

persuasion into play" (Stahl, 2003, p. 5). Changes are negotiated, then validated (Stahl, 2002). Finally, negotiation brings "ideas back into consensus and to promote individual ideas to the status of group knowledge" (Stahl, 2003, p. 3).

Modelling Social Knowledge Co-Construction

With the proliferation of the personal computer as an educational tool, researchers began to study the use of computer-based communication in learning environments. Early research studying interaction in online courses, once commonly referred to computer mediated communication or CMC (Kaye, 1991), focused on quantitative measures of participation, such as message posting frequency (Mason, 1991). Rourke et al. (2000) analyzed nineteen early content analysis studies. They concluded that many enthusiastic claims of asynchronous communication supporters had not been verified empirically. These claims, which include greater student reflection and finer message articulation, are made based on the inherent properties of the medium of communication rather than through valid experimental inquiry.

One of the earliest researchers to seek evidence of knowledge quality in CMC was France Henri. Her often-cited study was one of the first to investigate message content from online courses. Henri characterized CMC as "an entirely new means of communication" (Henri, 1991 p. 118). She sought to develop a model to describe the "richness and efficiency of CMC" (Henri, 1991, p. 120). "When content analysis of discussion boards is conducted for the for the purpose of understanding the learning process, information is revealed about learners and the learning process, including how they engage particular topics" (Henri, 1991, p. 118).

Henri's (1992) model is qualitative in nature, using "a priori criteria and a cognitive view of learning" as the basis for message characterization (p. 123). Its focus is on the "process of learning, rather than its product" (p. 123). The model prescribes analysis using a framework of

three elements: “what is said,” which can be assessed in terms of knowledge quality, “how it is said,” which reveals patterns of communication, and “processes and strategies,” adopted by the learner to regulate learning (p. 123-124). Henri acknowledges that while this model can provide educators with practical insights into the process of online learning, there are “conceptional” and “technical” limitations which may hinder the model’s efficiency (p. 134). Critics of Henri’s model include Hull (2009) and Gunawardena (1997) who found the model to be “mechanistic and descriptive, not central to the construction of knowledge” (Gunawardena et al., 1997, p. 407). Gunawardena et al. (1997) further claim that Henri’s model is tightly coupled with a teacher-centered paradigm and is therefore not tuned for discussions among adults. Still, authors of content analysis models that followed credit Henri with pioneering content analysis methods upon which they would improve.

Content analysis models stemming from the pioneering work of Henri (1992) include Garrison (1992), who identified five stages of critical thinking visible in student discourse. Newman et al. (1995) synthesized the work of Henri (1992) and Garrison (1992). Newman’s model paired indicators of Henri’s (1992) model elements and noted their occurrence in each of Garrison’s (1992) five critical thinking stages (Newman et al., 1995). Thinking beyond patterns of participation and critical thinking, Gunawardena et al. (1997) and Veerman and Veldhuis-Diermanse (2001) each created models specifically for knowledge construction. Veerman and Veldhuis-Diermanse’s model was presented along with a teaching and learning framework designed to promote quality interaction and student collaboration (2001).

While Veerman and Veldhuis-Diermanse’s (2001) model can detect knowledge construction as new information is rendered, refined and critiqued, Gunawardena et al.’s (1997) interaction analysis model IAM seeks to capture the evolution of knowledge construction,

differences in the quality of interaction, and the resulting knowledge constructed. They use the metaphor of a patchwork quilt to describe the social construction of knowledge. An individual's patch consists of their personal contribution. It contains expressions of their existing knowledge and experience along with indications of cognitive dissonance and attempts at resolving dissonance through negotiation. As students interact, the quilt is assembled. The individual contributions remain distinctive but their assembly with the others forms a unique pattern. As single interaction may not be enough to create a pattern, but as interactions continue, the pattern becomes more defined until at last the quilt is completed with the end result representing "the entire gestalt of the interaction" (Gunawardena et al., p. 411).

The model was developed using transcripts from a significant scholarly debate, where the participants were recognized leaders in the field of distance education. The expertise and scholarship of the participants, along with the rich theoretical nature of the subject matter, provided optimal conditions to observe the processes of negotiation and co-construction of knowledge in action. There are five distinct phases of the model which trace a group's knowledge construction processes as they transition from lower level mental functions to higher level mental functions through the process of negotiation.

The first phase of the model, sharing and comparing of information, include: observations or statements of opinion; statements of agreements; corroborating examples provided by one student in response to another; asking and answering questions; and offering definitions and descriptions. In the second phase, dissonance is uncovered as individuals react to the statements and opinions of the previous phase. Content in this phase consist mainly of statements: citing areas of disagreement; questioning or answering the nature of the disagreement; restatement of positions with increased support from personal experience, data, or literature. In the third phase,

participants work through dissonance by negotiating new meaning. This involves clarifying the meaning of terms, negotiating the weight of arguments, identifying areas of agreement, proposing new definitions, and proposals for integrating new definitions. In the fourth phase, new negotiated meanings are tested against: received facts, existing cognitive schema, personal experience of other group members, formal data, and contradictory evidence in other texts. Once successfully tested, the fifth phase is where the meaning of newly constructed knowledge is agreed upon. Statements in this phase consist of summaries of agreements, applications for newly constructed knowledge, and statements by individuals acknowledging their understanding or perspective has changed.

Gunawardena et al. (1997) acknowledge discussions will seldom reach the highest phases (Lucas et al., 2014). In addition, Gomez and del Rosario (2018) observe that in some socio-cultural contexts, students prefer to avoid the confrontational tone often found in level II discussions. Still, the depth and breadth of the model provide an opportunity for educators to evaluate their students learning and for instructional researchers to validate new methods of instruction designed to increase knowledge co-construction.

The Role of Power in Negotiated Meaning

Baker contrasts teaching and learning in the context of negotiation from Socratic teaching methods in which the teacher asks questions and the student answers them with the goal being established a priori by the teacher. In the latter case, the teacher holds a favorable balance of both expert and legitimate power (Northouse, 2019), while in the former case, the symmetry of interaction implies the participants be relative equals (Baker, 1994).

According to Conrad and Donaldson (2004), “Piaget, believed that effective discussions were only possible when there was symmetrical power between discussants” (p. 4). This

symmetry allows for participant give-and-take rather than submission to authority (Conrad & Donaldson, 2004). In developing the interaction analysis model, Gunawardena et al., (1997) specifically targeted participants who "brought to [their study] roughly equal levels of knowledge and roughly equal cognitive and metacognitive skills (p. 406).

Despite this apparent desirability for power parity in social knowledge co-construction and negotiated meaning, power parity among participants has not been formally operationalized and studied in social knowledge co-construction studies. Recent research by has touched on power relationships in knowledge co-construction, but not in the online graduate school context (Jean et al., 2018; Owusu-Agyeman & Fourie-Malherbe, 2019; Twalo, 2019). Howard et al. (2017) looked at shifting initiative among course discussion participants as an indicator social knowledge co-construction. Howard et al.'s initiative study could be seen as a study in power management if we consider Stahl's (2003) give-and-take definition of knowledge construction in combination with Conrad and Donaldson's (2004) interpretation of Piaget's requirement for effective discussions discussed previously. But to date, the relationship between power parity and knowledge co-construction has not been studied.

Social Network Analysis

This section provides an overview of core definitions and constructs common to social network analysis across all domains of inquiry, followed by various measures of these constructs or parameters, which are often used as variables in social network analysis studies. Although a "unifying logic" connects each social network construct, studies that measure and relate two or more constructs or parameters take place in varied contexts, which necessitates that researchers approach social network inquiry with a clear understanding of the unique social context (Borgatti et al., 2018, p. 8). A brief typology of social network studies follows the discussion common

measures in social network analysis as a means of bounding the research context to more carefully inform attempts at inference.

Definitions of Social Network Constructs

Definitions of constructs below include those defined in the set of "Fundamental Concepts in Network Analysis" (Wasserman & Faust, 1994, p. 17).

Actor or Node. Actors are the entities within a network. They can be individuals, such as workers in an office, or "collectives", such as companies within an industry or athletic teams within a league (Borgatti et al., 2018, p. 2).

Attribute. Actors or nodes may be defined, not only by their existence, but by a set of characteristics they embody. The actors belonging to a company's human capital network could, for example, contain attributes such as IT credentials or Six Sigma certifications.

Relational tie. Actors can have different types or multiple types of relationships connecting them. For example, two actors could know each other, one could supervise the other, or the two could be considered friends of one another. We say then, if actor "A" knows, supervises, or is friends with, actor "B" then they share these distinct relational ties, which can be studied, together or separately, using social network analysis. In landmark a social network study on the 15th Century Florentine banking system, researchers created two social networks, the first contained all persons with relational ties of marriage to Cosmo de Medici the second contained all persons connected to de Medici through relational ties of business association (Padgett & Ansell, 1993).

Dyad. Any pair of actors within a network forms a dyad. Each dyad may have one or more relational ties, or they may share no connection at all.

Triad. Sets of three actors, called *triads*, allow researchers to model more complex relationships such as "friend of a friend", which can be illustrated by the following. If A is friends with B and A is friends with C, then B and C share the relationship "friend of a friend". Baird and Ulanowicz (1989) studied triadic relations among species in the Chesapeake Bay ecosystem. Their analysis uncovered a remarkable condition in the predator-prey relation, namely that it was not uncommon for one species to prey on another during winter, but in summer, the prey of the second species could be a predator of the first (Baird & Ulanowicz, 1989).

Subgroup. The size of the set of actors under consideration, can be extended to any subset of network actors. A subgroup can be defined by any subset of network actors and the relational ties they share (Wasserman & Faust, 1994).

Group. The set of all actors in a network is known as the *group*. Identifying the group is an implicit part of bounding the social network. Although social networks are often constructed within concrete organizing frameworks, such as businesses or schools, analysts must clearly articulate group membership. For example, if modelling relationships in a grocery store, it would be necessary to state whether the set of actors (group) were restricted to employees, or whether the analysis included suppliers, contractors, or customers. Similarly, the group belonging to the social network of an elementary school might consist only of students, only of faculty, or it might include students, faculty, staff, parents, and members of the community. Group membership depends therefore upon the study's purpose and context.

Relation. This term describes any potential basis through which actors may share (relational) ties. Thus, it is an abstract concept of the social network that exists independently of the presence or absence of relational ties.

Network. The network can be conceptualized most simply as the defined group of actors and one or more relations they may share

Common Social Network Parameters

Social network studies generally measure and compare two or more parameters which describe or relate actors, dyads, subgroups, or characteristics of the network as a whole. While graph theory provides dozens of parameters, which may be useful in myriad research contexts, the set included here represents the most commonly used parameters in SNA studies of online learning networks and each are considered in the review of empirical literature which follows this discussion.

Tie Strength. Some relations, such as "supervision", are defined in part by the presence or absence of a tie. For example, Mary either is or is not John's direct supervisor. Other relations, such as "number of jointly-authored papers", require a numerical representation. These are known as "valued" ties (Wasserman & Faust, 1994, p. 140). For many relations, the research question or methodological preferences of the researchers inform the decision whether or not describe the ties by their relative value. Some social network parameters are only defined for dichotomous ties (Borgatti et al, 2018). To access these parameters, researchers can define a threshold value to dichotomize relational ties (de Lima, 2010). For example, if survey data based on Likert-scale data is used to define the relation "is friends with", the researcher has the choice whether to consider the strength of individual friendship ties or to define the relationship dichotomously by choosing a threshold value.

Directional Ties. While the supervision relation requires no value, it does require a direction. Mary supervises John is not equivalent to John supervises Mary. In social network

diagrams, directional ties have arrows depicting the direction of the relation. If Mary supervises John, this relation is indicated by Mary → John.

Centrality. When some members of a network have a greater number of ties or greater tie strength in their relations than others, they are said to have a greater degree of centrality. Numerous measures of centrality have been defined.

Freeman Degree Centrality. The most basic centrality measure, Freeman degree centrality measures an actor's total number of ties (Wasserman & Faust, 1994). In directional relations, the number of outbound ties is referred to as out-degree centrality, while the measure of inbound ties is called in-degree centrality (Borgatti, et al., 2018). When considering student interaction in an online discussion forum, instances in which a student posts a message is represented by an outbound tie, while in inbound tie is counted when a student receives a message. In and out-degree centrality are frequently referred to as prestige and influence respectively (Russo & Koesten, 2009). These terms should be used with a degree of caution as their English language definitions suggest social value, which requires context to evaluate. When it comes to online learning, the student who posts more frequently than others, does not necessarily contribute the most substance. As my eleventh-grade math teacher, Sister Margaret McKenna, OSD. was fond of saying, "empty barrels make the most noise."

Betweenness Centrality. If an actor lies along the shortest path between two other actors, he or she is between them. Actor A's betweenness centrality is determined by the total number of dyads whose shortest path between goes through A. In many social network studies, individuals with high betweenness centrality are considered "gatekeepers" between other actors (Borgatti, 2018, p. 201) or "information brokers" (Gunawardena et al., 2016, p. 54).

Closeness Centrality. The distance between two actors A and B is measured by how many actors A would need to pass through to reach B on the path linking A to B. An actor's closeness centrality then is a measure of the sum of all the actor's distances

Centralization. When only a few actors figure prominently, the network is said to exhibit a high level of centralization. Conversely, networks in which ties are more or less evenly distributed among actors has low centralization.

Cohesion. Conceptually, cohesion describes how connected a network is. Specific measures of cohesion include density and connectedness.

Density. In an unweighted or unvalued network, density is the ratio between the number of ties present in a network and the total number of possible ties there could be. For a fixed number of actors, the density increases with each new tie. Likewise, for a fixed number of ties, adding additional actors reduces network density. For a network of n actors, there are $n(n\text{-}1)$ possible ties. "As a result, densities are almost always lower in large networks than in small networks" (Borgatti et al., 2018, p. 175). Despite this limitation, few social network studies of the online learning environment exclude density as a measure of interaction.

Connectedness. This measure of cohesion is defined as "the proportion of pairs of nodes that can reach any other" by following various paths within the network (Borgatti et al., 2018, p, 178). Whenever, a network is not fully connected, it is said to be split into one or more components.

Cliques. In a valued network, a clique is a subgroup in which the average strength of ties is stronger "internally than externally" (Aviv et al., 2003, p. 5). Cliques can be useful constructs in studies that explore knowledge diffusion because the strength and connectedness of the clique minimizes the distance over which information must travel.

Relations between attributes and ties. Many studies investigate the relationship between common attributes among actors and the likelihood of their connection or the strength of their ties. An example of this would be a study of workplace friendships where the political affiliation of each actor was known. Such a study could investigate the extent to which political homophily correlates with friendship formation.

Typology of Social Network Studies

Social network analysis studies can assume two basic forms: theory of network studies and network theory studies. Theory of network studies look at the antecedent conditions leading to the formation of networks having various properties, while network theory studies investigate the consequences (usually in practical terms) of networks bearing particular characteristics (Daly, 2010). Additionally, a social network analysis research question may concern the nodal (actor-level), dyad, or *network level* of analysis. Borgatti et al. (2018) offers a typology of six studies consisting of the two forms and three levels of analysis.

Type 1: Dyad-Level Theory of Networks. Studies of this type seek to understand the conditions leading to tie formation among members of dyads. Questions of homophily, as discussed previously may be answered by this type of study.

Type 2: Dyad-Level Network Theory. Studies of this type seek to explain the consequences of ties between individuals. An example would be a reversed form of the homophily study, such as exploring the extent to which friends have a common attribute.

Type 3: Node-Level Theory of Networks. Studies of this type explore connections between an actor's attributes and his or her place in the network. In a multi-cultural learning context, one could explore the relationship between English language proficiency and

Type 4: Node- Level Network Theory. Studies of this type seek to determine whether a person's position in the network is predictive of some type of outcome. An example might consider whether individuals with high levels of betweenness centrality are more likely to be promoted than others.

Type 5: Network- Level Theory of Networks. Studies of this type might investigate how external factors may predict network characteristics. A study of faculty cohesion before and after an announcement that the school is to be permanently closed would fit this type.

Type 6: Network- Level Network Theory. Studies of this type may ask what can be accomplished by teams having certain characteristics. An example may look at some form of network cohesion as a predictor of successful task accomplishment.

Distinguishing Social Network Characteristics of the Online Learning Environment

Before reviewing the current literature of social network analysis studies about knowledge co-construction, a couple of distinctive features and conventions common to such studies is necessary. When analyzing discussion boards or similar online forums, the general SNA convention for defining an interaction relation is an arc or edge, where an edge from A to B represents an event where student A directs a post or comment to student B. This traditional definition is consistent with workplace dynamics research, such as that of Granovetter (1973), whereby "small-scale interactions" relate to "macro-phenomena" including "social mobility" and "political organization" (p. 1361) and other studies belonging to the "social capital paradigm" (Borgatti et al., 2018, p. 315). In social capital studies, connections represent differential access among actors to resources and the pathways through which they may be "mobilized" (Moolenaar & Sleegers, 2010, p. 99).

In addition to defining edges, online learning environments have an ambiguity not found in the social networks of workplaces, namely the definition of a node or actor. "Actors are discrete individual, corporate, or collective social units (Wasserman & Faust, 1994, p. 17). When defining nodes, "we normally expect them to be active agents, rather than, say, inanimate objects" (Borgatti et al., 2018, p. 2).

Applying the traditional interpretation given these two commonly used descriptions, how would one characterize actors in the central discussion forum of the online course? Using the principle of actors as active agents, we would not consider the forum itself to be an actor. However, when a centralized discussion forum is used, messages can be considered posted to the forum just as well as they could be posted to a named individual. Social network studies that adhere to this conceptualization, such as Tirado et al. (2010) have, by default, the forum as the highest centrality actor. Most studies do not consider the forum as an actor, but they do so by ignoring the fact that all posts can be read by all students. Such studies would be fallacious if they adopted a social capital perspective in which exclusive access to individuals is regarded as a source of power. Such a perspective overlooks the fact that though two students may have not communicated, they are free to do so at any time and require no broker to mediate a connection.

Empirical Research in Social Knowledge Co-construction and Patterns of Interaction

Empirical studies of social knowledge co-construction in online learning environments generally fall into one of two categories: (a) studies concerned with identifying or measuring knowledge co-construction, or analyzing the process through which students co-construct knowledge (Buraphadeja, 2010; Heo et al., 2010; Hou et al., 2009; Gunawardena et al., 1997, 2016; Gomez & del Rosario, 2018; Lucas & Moreira, 2010; Sing & Khine, 2006; Tan & Huang-Yao, 2008; Veerman & Veldhius-Diermanse, 2001) and (b) studies testing instructional

treatments designed to improve or increase student knowledge co-construction (Aviv et al., 2003; De Wever et al., 2010; Hull & Saxon, 2009; Xie et al., 2014).

The Interaction Analysis Model (IAM) was created in the process of conducting a computer-mediated debate in a pre-conference virtual forum of the International Council on Distance Education (IDCE), concerning trends and prescriptions in the emerging field of distance education (Gunawardena et al., 1997). Inspired by Henri's (1992) content analysis model, Garrison's (1992) critical thinking content analysis model and subsequent model enhancement by Newman et al. (1995). The study's structured debate context placed experienced individuals on opposing sides to various propositions relevant to their field. The authors found significant evidence of social knowledge co-construction, inspiring over two decades of follow-on inquiry (Gunawardena et al., 1997).

Despite the promise of the original study, subsequent research in related contexts, such as online professional development (Hou et al., 2009; Sing & Khine, 2006; Tan & Huang-Yao, 2008) communities of practice (de Laat, 2002;), online graduate courses (Buraphadeja, 2010; Gunawardena et al., 2016; Gomez & del Rosario, 2018), and online undergraduate courses (Heo et al., 2010; Veerman & Veldhius-Diermanse, 2001; Wang, 2009) found a scarcity of social knowledge co-construction in message postings and postings with IAM level 1 statements comprising the vast majority of posts. A common lesson of these studies is a realization that students rarely engage in knowledge co-construction without a well-designed set of instructional activities. In addition, cultural considerations may limit student tendencies to challenge each other directly (Gomez, 2018; Jayatilleke & Gunawardena, 2016; Sing & Khine, 2006). Therefore, course designs relying solely on debate will have limited use in many cultural contexts.

Enabling Greater Levels of Social Knowledge Co-construction

As discussed previously, several researchers have designed treatments to promote greater student-to-student engagement and social knowledge co-construction. Hull and Saxon (2009) developed a technique where discussion moderators augment weekly discussions with an "intercedent question" given a midweek with the intention of pointing out divergent patterns of thought among discussants, providing a source of dissonance to be resolved through negotiation (p. 630). In their counter-balanced, quasi-experimental design, the researchers claim improvement in the average IAM level associated with each student utterance. Data for the treatment and control groups were compared using the Kruskal-Wallis (*H*) rank sums test, where they reported an *H*-value of 65.017 which is statistically significant ($p < .001$).

A possible answer to the cultural sensitivity towards students challenging one another directly, Nash (2011) designed a treatment in his online leadership course where students would indirectly confront and attempt to reconcile peer differences. Rather than having students respond to a peer post, Nash had his students read a peer posting and then re-write his or her original, reflecting insights gained from reading. This method may also counter the effects of social distance and fear, as discussed in the human resources frame analysis, (Freedman et al., 2003) by allowing students to reflect on their peers' divergent views while confining the dialectical to the individual rather than in open debate. While Nash did not use any model to quantify social knowledge co-construction, qualitative analysis of his discussion boards post-treatment revealed evidence of changed perspective, a key component of socially constructed knowledge construction (2011).

De Wever et al. (2010) and Xie et al. (2014) each studied the impact of student role assignment as an enabler of social knowledge co-construction. Xie et al. assigned students as

moderators on a rotating basis while De Wever assigned students to five distinct roles. These roles were “starter, summarizer, moderator, theoretician and source searcher”, and provided an imperative for students probe questions more deeply, challenge assertions, and build warranted assertions (De Wever et al., 2010, p. 179). As discussed during the structural frame analysis, Wenting (2017) added customized student roles but with the intent to increase participation rather than social knowledge co-construction specifically. De Wever et al. compared the IAM levels of the individual student post in a multi-level model while as Xie et al. (2014) relied on network density of high-performing moderators as a proxy for social knowledge construction noting that quality moderation entails thoughtful reflection and analysis. Both studies found student role assignment valuable in promoting social knowledge construction.

Recognizing the imperative that social knowledge co-construction in the online learning environment requires a deliberate instructional design, Aviv et al. (2003) designed an interaction framework based on the work of Gerva (2001) through which students evolved a solution to a complex, business-related case study. Students performed a set of interdependent tasks in phased alignment with the interaction analysis model (Gunawardena et al., 1997). In the first phase, students defined the problem, proposed, and discussed solutions, and converged on a shared solution. In each of the next three steps, they evaluated proposed solutions against various moral and ethical theories before summarizing and presenting in the final phase (Aviv et al., 2003). The framework could be considered a type of scaffolding as it provided a roadmap to the elusive higher levels of knowledge co-construction.

Measuring Social Knowledge Co-Construction

Studies that measure social knowledge co-construction, whether using the interaction analysis model or not, must address two important considerations: the unit of analysis and the

method of quantitizing co-constructive discourse. Henri's original content model identified units of meaning as the basic unit of analysis (Henri, 1991). Subsequent model developers such as Gunawardena et al. (1997) and Veerman and Veldhuis-Diermanse (2001) chose the individual student post as a more objective unit. While the individual student post is readily identifiable, researchers using the model had to define additional conventions, such as how to evaluate posts containing evidence of more than one model phase of knowledge how to account for messages not indicative of social knowledge co-construction. Veerman and Veldhuis-Diermanse (2001) created a separate typology of message types that could be used as indicators of student support, analogous to indicators of social presence (Rourke et al., 2001). Similarly, Hou et al. (2009) added a sixth category to the IAM for all statements considered to be "irrelevant" (p. 329).

While most model users adhere to the convention of using the individual message post as the unit of analysis, Tirado et al. (2012) and Heo et al. (2010) opted for Henri's (1991) units of meaning. Tirado et al. sought to encode all meaning units, which allowed them to look at the distribution of meaning units at each level, while Heo et al. (2010) recorded the highest meaning unit within a post but coded each unit sequentially to preserve information on the process through which knowledge was constructed.

Once the unit of analysis is selected, studies attempting to measure co-construction levels achieved by individual students must define a convention for quantitizing contributions. Some studies, such as Gomez and del Rosario (2018) and Gunawardena et al. (2016) recorded the highest-level knowledge co-constructed by a student within a course segment but did not attempt statistical analysis of individual student contributions.

Many studies measured student contribution by scoring the highest level of construction contained within each student's post (Aviv et al., 2003; Buraphadeja, 2010; De Wever et al.,

2010; Heo et al., 2010; Hull & Saxon, 2009). Descriptive statistics, such as means and standard deviations of IAM scores, when applied to student contribution, are problematic for two reasons. First, the IAM has an ordinal scale (Gunawardena et al., 1997), so the use of mean as a measure of central tendency is not appropriate (Ross & Shannon, 2011). Arguments can be made however to treat IAM level as a continuous variable. Within each level, Gunawardena et al. (1997) define between three and five sub-levels, presented in order of increasing sophistication, that is, each sub-level represents a move towards the next level. However, even when allowing an assumption of ordinality, using the IAM level of a single post as the sole measure of a student's contribution is problematic because considering messages in isolation, overlooks the social element of the construction.

Consider a threaded discussion culminating in a statement of agreement about the application of a recently co-constructed idea. By convention, the student who made that statement would be scored as a "5" while the student who uncovered the divergent assumptions providing the entire context of the debate would have his or her contribution scored as a "2". This would be akin to looking at a skyscraper and valuing the contribution of those who placed the antenna more so than those who poured the foundation or reinforced the structure. Studies looking to associate knowledge co-construction with patterns of interaction or other characteristics require a method to measure individual contribution while preserving the value of the construction itself.

Social Network Analysis and the Interaction Analysis Model

Several studies of online social knowledge co-construction have taken a two-pronged approach: using the interaction analysis model to consider micro-level interactions and social

network analysis for a macro view (Aviv et al., 2003; Buraphadeja, 2010; De Laat, 2002; Gomez & del Rosario, 2018; Gunawardena et al., 2016; Heo et al., 2010; Sing & Khine, 2006)

Measuring Contributions to Social Knowledge Co-Construction. As discussed, studies in this review relied on different methods to measure individual student contribution to the process of knowledge co-construction. This resulted in differences of meaning and implication associated with the observed values of various social network analysis parameters. De Laat (2002) evaluated each post with an overall IAM score and he computed social network analysis parameters for the totality of participant interaction. He reported a distribution of IAM scores for all message but did not attempt to link these to the SNA parameters.

When considering message posts with multiple IAM level statements, Buraphadeja (2010) and Sing and Khine (2006) each adopted the convention of coding individual statements at the proper level but scoring only the highest-level message in the post. However, Sing and Khine (2006) resembled De Laat (2002) in that they discussed the level of interaction and the quality of discourse (revealed in the frequency distribution of messages at each IAM level), but offered no connection between the two measures beyond noting the relatively high density of their network was an indication of a "relatively conducive environment for collaborative knowledge building" (Sing & Khine, 2006, p. 256). Buraphadeja (2010) by contrast specifically tested for correlation between IAM message levels produced by each student and that student's measures of centrality. No significant correlation was found (Buraphadeja, 2010).

Gomez and del Rosario (2018) preserved multiple IAM levels within posts by noting the IAM level of individual segments within a single post. Further, they preserved the order in which messages contributed to the overall co-construction by ordering the edges of the sociogram chronologically. The result was a more complete illustration embodying both the

individual contribution and the process of construction. They connected the evidence of social knowledge co-construction to the characteristics of the resulting social network in a manner similar to de Laat (2001), namely noting that the patterns of interaction appeared favorable for the co-construction of knowledge (Gomez & del Rosario, 2018). Gomez and del Rosario (2018) further added that "centrality measures provide sound indicators of a student's ability to transfer information and exert influence over other students" but they did not attempt statistical correlation between these indicators (p. 298).

Social Network 'Edge' Definition. While each of the studies reviewed here relied on the traditional edge definition (discussed previously), in which directed edges represent a message sent from one student to another, Gunawardena et al. (2016) offered a novel edge definition whereby an edge from A to B represents the case where Student B references or mentions an idea introduced by Student A in a subsequent post. This convention has two important consequences. First, it separates itself social capital theory by implicit recognition of the fact that unlike relationships of the business or human resources world, peers enrolled together in online courses have equal access to one another and generally, posts made in central discussion forums can be read by all. Second, in the specific context of social knowledge co-construction, Gunawardena et al. (2016) notes that "mentions" made during the process of knowledge co-construction provide direct evidence of individual contribution (p. 43).

With a radical departure of conventional edge notation, traditional social network measures, such as measures of student centrality and network cohesion take on new meaning. Betweenness centrality for example is now defined as a direct measure of individual student contribution to social knowledge co-construction. Although this approach is both elegant and novel, there are still limitations associated with its use. First, it requires students to attribute the

sources of influence behind their ideas, which may formalize dialogue and limit participation. Second, while this approach captures participation in the process social knowledge co-construction, it does not uniquely capture participation that advances a co-construction to a higher level.

Conclusion

This review of literature began with a four frames analysis of the online environment, with emphasis on social knowledge co-construction. The structural frame motivated the potential of discussion boards to be places of dialogue rather than digital folders for posting messages; and as places of authentic self-expression rather than where you check the box for participation (Ringler et al., 2015). The human resources frame explored the concept of social distance as an all too common inhibitor of self-expression (Freedman et al., 2003) and the central role of the instructor in breaking through this barrier (Draves, 2003; Simonsen et al., 2015). The symbolic frame revealed how the value and meaning of social knowledge constructions can become deeply personal (Powell & Kalina, 2009) and that establishing online learning communities requires elements of social presence (Rourke et al., 2001; Swan, 2002). Once established, membership in a learning community can serve as an extension of the self. Finally, the political frame uncovered power relationships in the online learning environment. A typology of power (Northouse, 2019) informs us that although students may be equal in terms of legitimate power, they may have considerable differences in expert power, which may influence their ability to co-create knowledge or negotiate meaning.

The four frames discussion was followed by a theoretical discussion to motivate the use of social knowledge co-construction in online learning in terms of its epistemological and pedagogical value. The discussion was grounded by framing it in its relationship to its parent

theories including Piaget's cognitive constructivism (1967), Vygotsky's social construction (1986), Papert's and Harel (1991) constructionism, and relevant negotiated meaning theory from Baker (1994) and Stahl (2003). Various content analysis models for evaluating online discourse were explored culminating with the identification of the interaction analysis model (Gunawardena et al., 1997) as the most relevant for studying both the product and the process of social knowledge co-construction.

A brief discussion of social network analysis followed a discussion of basic SNA constructs borrowed from graph theory, with definitions provided primarily by Borgatti, et al. (2018) and Wasserman & Faust (1994) along with a typology for classifying social network studies. Specific considerations of SNA of online networks were considered, including the fact that unlike in workplaces, where conversations are typically restricted to very small subgroups, the entire group of online students can view all discussions in the central discussion forum and students generally do not require mediators or gatekeepers to allow access to student within the group. The implications of which were discussed subsequently in the review of empirical studies.

Content analysis studies of online social knowledge co-construction using social network analysis generally sought either to describe the co-construction process and the resultant patterns of interaction, or they sought to improve instruction to enable students to reach higher levels of knowledge quality. Synthesis of these studies revealed several facts. First, a majority of student discourse is confined to the lowest levels of the interaction analysis model. Second, carefully constructed instructional activities (Aviv et al., 2003), purposeful student role assignment (De Wever et al., 2010), and culturally sensitive alternatives that promote critical thinking without direct confrontation (Nash, 2012) can promote knowledge co-construction. Third, despite

assertions by well-known educational theorists, such as Piaget, that equality among discussants is needed for knowledge co-construction, no empirical studies could be found to validate this claim. Finally, a consistent framework for measuring student contribution to social knowledge co-construction is needed. Studies attempting to explain patterns of interaction and network attributes of contributing students, produce inconsistent results in part because of this methodological gap.

Chapter III: Methods

The purpose of this study was to examine ways in which differences in experience levels, patterns of participation, and fulfillment of assigned roles shape the patterns and degree of social knowledge co-construction achieved by graduate student professionals enrolled in online educational leadership course. The review of literature described six different types of power that may exist in a leadership context (Northouse, 2019). Of these, expert power is a measure of personal credibility that comes from perceptions of one's knowledge and experience. The first part of this study looked at how differences in expert power may create imbalances between students and how this imbalance may limit the extent to which pairs of students co-construct knowledge in asynchronous online discussions. The second part of this study shifts focus from pairs of students to the dynamics of knowledge co-construction in large group discussions. To aid in this line of inquiry, the researcher presented a framework for identifying individual contributions to knowledge constructions. This framework, used in conjunction with the interaction analysis model (Gunawardena et al., 1997) and social network analysis allowed the researcher first to explore the relationship between participation and contributions to co-construction and then observe the patterns of knowledge co-construction as students performing differentiated, assigned roles engaged in case study analyses.

Research Questions

1. What is the relationship between power parity and the level of social knowledge co-construction/negotiated meaning among paired-student threaded discussions in an online educational leadership course?
2. What relationships are seen in the patterns of student participation and the patterns of knowledge co-construction? This question is further decomposed.

2a. How does the network prominence of students performing specialized roles (facilitator, catalyst, search engine, summarizer) relate to the overall density of the co-construction network during each phase of discussion?

2b. What relationships are observed between student's network centrality (out-degree, in-degree, and betweenness) in the participation network and his or her contribution to knowledge co-construction?

The literature review motivated social knowledge co-construction as a concept having significant epistemological and pedagogical value, particularly among graduate student professionals studying highly contextual and experiential subject matter. A review of empirical research revealed that certain theoretical assumptions about how knowledge can be co-constructed in the learning environment, such as the desirability of power equality among discussants, remain unexplored. In addition, while numerous studies have examined the relationship between various levels of knowledge co-construction students achieved and the patterns of interaction through which knowledge was constructed, there is no agreed-upon framework for measuring individual contributions to knowledge co-construction. These two gaps have impacted research in this area of study. First, course treatments designed to increase social knowledge co-construction are assessed without consideration of any confounding effects of power imbalance among students. Second, studies that explore the social network characteristics of students who contribute to high-quality co-constructions generally rely on group constructions as proxies for individual contribution, or they apply statistical tests directly to the ordinal values of the interaction analysis model, which are generally reserved for continuous variables. These two gaps were addressed sequentially in the present study through two research questions. The first research question addressed relationship between power parity

and knowledge co-construction in paired student discussions. Next, the study introduced a logical framework for measuring individual contributions to knowledge co-construction, which addressed the methodological shortcomings described. Using this framework, the second research question looked at the patterns of knowledge co-construction contrasted with the patterns of active course participation. Further the research context developed to engage these questions was designed to promote knowledge co-construction. Two well-documented approaches from the literature were used for this purpose. First, students were rotationally assigned to specialized roles emphasizing social co-constructive practices. Second, discussions were organized in phases designed to progress through higher levels of co-construction over time. The patterns of co-construction in each phase were visualized along with the contributions of students performing specialized roles to support graphical inferences. Finally, at the individual level, student social network attributes of participation were examined in relation to the level of contribution to social knowledge co-construction.

Method

This study employed a convergent mixed methods design (Creswell & Plano-Clark, 2018). Although the study's research questions were more quantitative than qualitative, a mixed-methods approach was most appropriate. The interaction analysis model (Gunawardena et al., 1997), one of the two data collection instruments in this study, converts qualitative discussion board data into quantitative measures of knowledge co-construction. Once converted, the data can be compared to other quantitative data to explore relevant relationships. The purpose of using mixed methods was complementarity, that is using both qualitative and quantitative strands "to increase the interpretability, meaningfulness, and validity of constructs" (Greene et al., 1989, p 259). Specifically, the study sought to understand the process through which students co-construct knowledge in the online learning environment. Using both qualitative and quantitative

sources allowed the researcher to observe relevant constructs simultaneously. Figure 2, adapted from Creswell and Plano-Clark (2018), illustrates the basic study design, which is presented in much greater detail following the data analysis discussion.

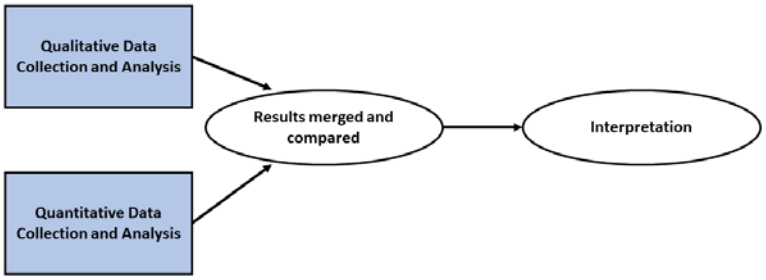

Figure 2. Convergent Mixed Methods Research Design

Participants

The study's participants (n = 19) were recruited from the pool of graduate students at a large southern university enrolled in a PhD-level course in educational leadership theory and practice, delivered using a combination of face-to-face and online methods. A total of nineteen students were enrolled in the course and all nineteen students agreed to participate in the study. This group was chosen using purposive and convenience sampling (Tedlie & Yu, 2007). It was purposive because the course's learning objectives require the students to draw on their professional experiences – a favorable context for studying social knowledge co-construction. In addition, this hybrid course was recently re-designed to promote higher-quality student-to-student interaction during the online portion of the course. The participants were a convenience sample because of the researcher's access to course, the students' enrollment in the selected course, and because their participation was voluntary. The researcher used a concurrent, mixed methods sampling strategy, relying on a "single sample of participants where qualitative and quantitative data are collected simultaneously but not necessarily at a single point in time" (Creamer, 2018, p. 121). Other than the initial survey instrument, which was administered at the start of term, participation was passive. Consent was required to access student writing posted to

course discussion boards. To recruit and consent participants, the researcher followed an institutional review board-approved script, which is found in Appendix A. Students were given details about research activities, risks associated with their participation, measures to safeguard against these risks, and their status as volunteer participants, which could be terminated at any time upon their request.

Research Context

Data for the study were collected over a 15-week period during the Fall 2019 term within a graduate level educational leadership theory course. The instructor taught the class using a combination of face-to-face and online approaches. The face-to-face component consisted of three full-day sessions while the online component consisted of weekly reading and writing assignments. These assignments were of two types, weekly paired discussions, and large-group major case studies, which were conducted over six-week periods.

Weekly Paired Discussions. Each week, students were assigned to read a chapter of the course text, which described a leadership theory or model, and a case study describing a challenging situation set in an educational leadership context. Students answered a writing prompt addressing one or more elements of the case, in terms of that week's leadership theory. Once submitted, the student was randomly assigned to read an anonymous classmate's response to the same prompt. Next, the students were asked to re-write their own responses, acknowledging and applying insights from their partner's perspective. Once both partners submitted their re-written responses, the partners' identity was revealed and the pair exchanged posts and engaged in crafting a final statement which would either explicitly reconcile differences and present a shared perspective or acknowledge remaining differences while stating areas of agreement or overlap between perspectives. The design of this assignment was inspired

by Nash (2011) who successfully applied similar methods to improve interaction quality among online students.

Large Group Major Case Studies. Each week students contributed to a half-semester length case study discussion in which they developed shared solutions to a complex problem. The structure of the discussion was derived from Aviv et al.'s (2003) five-phase model, which was designed mirror the five levels of the interaction analysis model (Gunawardena et al., 1997), and Gerva's (2001) Ethical Decision Model. In the first phase, students collectively framed the case by identifying its central problem or conflict. This phase was designed to put initial facts and opinions on the table, while identifying early signs of disagreement. In the second phase, students generated candidate solutions and reconciled them through negotiation. Activity during this phase was intended to evolve statements of individual perspectives and areas of acknowledged disagreement into co-constructed solutions embodying negotiation and compromise. In the third phase, students were asked to test their solutions against various leadership theories and models, adjusting and improving their solution as needed. In the final phase, the students contributed statements summarizing potential applications of lessons learned in their professional practice and described how their views have evolved over the course of the case study discussion. Table 1 maps the four phases to the IAM level statements expected for each.

Table 1

Major Case Study Phases and Expected IAM Levels of Associated Discourse

Phase	Expected IAM Level
1. Problem Identification (week 1)	Level 1 statements of opinion or fact Level 2 statements of disagreement
2. Solution Generation (weeks 2 & 3)	Level 1 statements of opinion or fact Level 2 statements of disagreement Level 3 negotiations or collaborative statements
3. Solution Testing & Refinement (weeks 3 & 4)	Level 2 statements of disagreement Level 3 negotiations or collaborative statements Level 4 Testing of ideas against various criteria
4. Reflection & Lessons Learned (week 5)	Level 5 Applications of co-constructions or statements of changed perspectives

In addition to the phased structure of the case study, students were assigned to one of five specific roles, modeled after the work of De Wever et al. (2010) and Strom and Strom (2002), on a weekly, rotational basis. These roles were:

- Facilitator. This student was responsible for keeping the students on topic and progressing towards deadlines.
- Catalyst. This student played a devil's advocate role, identifying sources of disagreement and highlighting contradictions and unwarranted claims.
- Search Engine. This student was responsible for locating additional resources to further solution development. These sources could include, for example, journal articles discussing relevant application of specific leadership models or theories or credible data sources containing facts and figures applicable to the problem domain.
- Summarizer. This student synthesized the week's discussion into a coherent expression of the state of problem resolution at week's end.

- Participants. Students not assigned to specialized roles were asked to contribute to the discussion, according to the posted instructions of the current phase.

Data Collection, Sources, and Instruments

This study consists of two research questions, which rely on *two* data sources and *four* analysis instruments. Table 2 shows the sources and instruments used to address each research question and the sections that follow, describe the instruments and their use.

Table 2

Data Sources and Instruments used for each Research Question

Research Question	Data Sources and Instruments
RQ1. What is the relationship between power parity and the level of social knowledge co-construction/negotiated meaning among paired-student threaded discussions in an online educational leadership course?	Data Sources: (1) Weekly paired discussion transcripts (Canvas); (2) Experience survey (Qualtrics) Instruments: (1) Interaction Analysis Model
RQ2a. How does the network prominence of students performing specialized roles (facilitator, catalyst, search engine, summarizer) relate to the overall density of the co-construction network during each phase of discussion?	Data Sources: (1) Major case study discussion transcripts (Canvas) Instruments: (1) Interaction Analysis Model; (2) Student Contribution Ruleset; (3) Social network analysis (UCINet); (4) Network Visualization (NetDraw)
RQ2b. What relationships are observed between student's network centrality (out-degree, in-degree, and betweenness) in the participation network and his or her contribution to knowledge co-construction?	Data Sources: (1) Major case study discussion transcripts (Canvas) Instruments: (1) Interaction Analysis Model; (2) Student Contribution Ruleset; (3) Social network analysis (UCINet); (4) Regression Model (SPSS)

Experience Survey (Qualtrics). The survey's purpose was to inventory the experience level of each student concerning common issues faced by educational leaders. Topics of interest were extracted from the course's set of educational leadership case studies (Northouse & Lee, 2019). Experience with each topic was used as a measure of expert power (Northouse, 2018) held by each student at the start of each paired discussion. The survey asked participants to rate their knowledge and experience with each topic in the set. Examples of topics from the survey

included managing after school programs, program oversight across multiple schools, and school budgeting. A six-point Likert-type scale was used for students to report their knowledge and experience such that a value of "1" indicated *none*, while a value of "6" indicated *extensive* knowledge and/or experience. The complete survey is found in Appendix E. To enhance construct validity, the course instructor reviewed the proposed list of topics for each case study and confirmed the primacy of each topic within each case study.

The Interaction Analysis Model (IAM). In this study the IAM is used both as an instrument to evaluate individual statements and as a measure of the overall quality of a co-construction artifact, which in this study, is a threaded discussion. To use the IAM, researchers generally take the transcripts from student discussions and consider whether each statement belongs to one of the five levels of social knowledge co-construction. Table 3 adapted from Gunawardena et al (1997), describes the five levels. The full model has greater granularity, presenting three to five sub-levels within each level. See Appendix F for the complete model, which was used in the current study.

Table 3

*The Five Levels of the Interaction Analysis Model**

Level	Description
1	Sharing/comparing of information – opinions, facts, and definitions
2	Discovering and exploring dissonance or inconsistency among ideas
3	Negotiation of meaning/co-construction of knowledge
4	Testing and modification of proposed co-constructions
5	Agreeing on and applying new ideas; evidence of metacognitive change

*Adapted from Gunawardena et al. (1997).

Ruleset for Measuring. This instrument is used to answer research question two by defining a clear, reproducible process for documenting student contribution. As discussed in Chapter Two, previous studies in this area of inquiry contained methodological and interpretive shortcomings in attributing social knowledge co-construction to individual students. A common

shortcoming was privileging instances of higher IAM-level contributions over continuous contribution at foundational levels. The instrument proposed in this study is described using a ruleset which defined in the following section. This ruleset is designed to recognize contributions at all IAM levels, provide that they serve to advance the quality of the co-construction. Chapter Four presents many annotated examples illustrating how the ruleset was applied to collected data.

Before the ruleset is presented, recall from Chapter Two that most IAM studies specify the message post as the unit of analysis. However, each statement in the post must be evaluated in context to determine the IAM score assigned to the post. By convention, the highest-level statement in a post determines the score of the post. Thus, the term unit of analysis as it is applied to this type of analysis is rather ambiguous. To avoid this ambiguity, the current study will not declare a unit of analysis but will simply state that since a co-construction is an artifact created by two or more individuals and since a message post is written by a single individual, the present study evaluates the entire threaded discussion when assessing the IAM-level of the construction. Contributions are made in individual posts, which contain multiple statements. Each statement can either advance the thread's IAM level or not. Therefore, to evaluate a co-construction two simple rules are applied to individual statements within each threaded discussion.

1. A statement made which advances the construction earns its author 1 point.
2. Students earn an additional point when their statements transition the construction to higher IAM levels.

Although simply stated, a couple of clarifications are needed. The first of these concerns how to define statements that advance the construction. Recall from the discussion of the IAM

that Level 1 statements include expressions of opinion or presentations of facts. Such statements can be distinguished by their conventionality, that is the extent to which such statements adhere to established convention, norms, commonly held perspectives, and direct quotes from the course materials. Such statements represent existing constructions and by themselves add nothing new. By contrast, unconventional statements which defy convention, contradict so-called 'established fact' and are likely to demand a future defense, set the stage for new knowledge co-construction as these ideas contain the seeds of dissonance to which other students may respond. Therefore, when applying the ruleset on a threaded discussion, Level 1 statements were credited with advancing the construction when evidence was found in subsequent posts that the statement triggered a response. In addition, multiple statements at the same IAM level could still advance the construction. For example, a negotiation may involve several students and require several proposals before agreement is reached. Proposals deemed unsatisfactory by other discussants may nonetheless have value by setting boundaries or by inspiring further efforts. Likewise, multiple testing statements at Level 4 can add nuance to constructions even if Level 5 is not ultimately reached. Even statements made at levels lower than the current level can advance the construction. For example, if two students are negotiating at Level 3 and a third student joins in with a Level 2 disagreement, concerning perhaps an argument's premise, this challenge calls for the existing construction to be refined or defended in light of a new challenge.

Social Network Analysis. Research question two considered two types of online relations among students – the direct exchange of posts and responses between specified students, independent of any knowledge co-constructed and statements and reactions to statements contributing to tangible gains in knowledge co-construction quality as measured using the interaction analysis model (Gunawardena et al., 1997) and the student contribution ruleset.

This second type is distinguished from the first, not only in that it represents a gain in knowledge co-construction but also terms of in the structure of network edges.

The participation network was constructed from the first type, which represents the complete set of direct communications between all students participating in a given case study. Each post and response were converted into an entry in a 19x19 matrix *P*, such that each element, $P(i, j)$ was assigned a value equal to the total number of times Student I posted or responded to Student J.

The contribution network was built from the second type of relation, which included both direct statements and indirect reactions. Indirect interactions are those instances when a student reacts to a statement made by another that was not directed at that student but was nonetheless readable by all participants. Every time a student earned a point in accordance with the ruleset, the element of contribution matrix of a given phase, $C_p(i, j)$ was incremented where Student I was the individual to whom the contribution was credited and Student J was the individual who recognized the contribution as evidenced by his or her response.

Data Analysis

The following sections illustrate the analysis steps followed to address the study's two research questions.

Research Question 1. Analysis steps for the ten weekly paired discussions:

1. After students submitted their initial responses to the weekly discussion prompt, the researcher paired the discussants using random sampling without replacement. That is, pairings were drawn from the set of all possible student pairings, but no pair was matched more than once.

2. Based on the major educational leadership topics associated with the weekly case study, the researcher calculated the difference between the means of each paired participant's experience scores. To illustrate, the first weekly case study contained the following main topics: management of afterschool programs; overseeing programs in more than one school at a time; budget creation and management; and hiring personnel. These four topics corresponded to four survey items from the experience survey. If the mean experience scores of two paired participants were 4.2 and 2.7 respectively, their power differential was calculated as $P_D = 4.2 – 2.7 = 1.5$.
3. Two secondary power measures were derived from the survey. Survey participants indicated their number of years' experience as educators and as educational leaders. Subtracting the two experience values between pair members produced two experience differentials.
4. Five artifacts were considered in determining the IAM level of paired discussions, the two original posts, the two revised posts, and the shared statement.
5. The cumulative set of paired scores were collected such that each data element took the form of a quadruple ($P_{D(i,j)}, E_{D(i,j)}, L_{D(i,j)}, I_{(i,j)}$) with the pair's power differential described in the first three elements and the IAM level achieved in their discussion in the fourth element.
6. Through the course of data collection, two additional potential sources of variance were detected. First, the mean scores of the class varied considerably. Second, students who consistently achieved high scores could potentially score higher when paired with similar students, regardless of the level of parity. A multiple regression model was built to test the significance of the power measures in predicting IAM

level, while controlling for the two additional sources of variation. Model details are reviewed in Chapter Four. Figure 3 provides a graphical representation of RQ1 data collection and analysis.

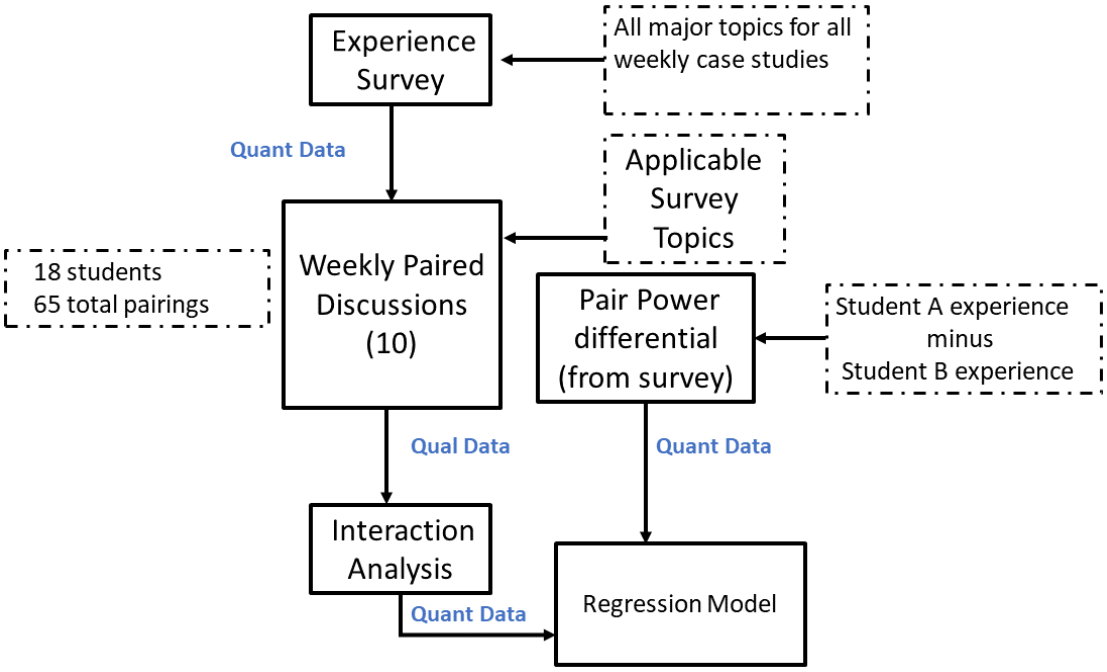

Figure 3. Graphical Depiction of Research Design for RQ1

Research Question 2. To analyze large group discussions, the sequence of threaded messages was analyzed using three instruments. Discussion boards are inherently mixed data sources as the discourse they contain is qualitative while the frequencies in the patterns of posting among students are quantitative. The analysis steps for the major case study discussions describe how these mixed data were deconstructed and compared.

1. For each phase of discussion, the researcher read the student-authored discussion prompt and all initial participant posts. To be considered a co-construction, an idea must be engaged by more than one student. Therefore, statements with potential to spur further discussion were flagged but not yet credited with co-construction.

2. Response posts were read for reactions to original posts. These reactions resulted in contribution credit awarded to the original poster. In accordance with the ruleset, whether the response simply acknowledged a previous idea or attempted to expand it further, determined the contribution of the responder. The contribution matrix of each phase was incremented accordingly.
3. Contribution scores were encoded as social network attribute data, such that each node (student) had an integer measure (contribution score) as an attribute.
4. The contribution matrices were loaded into UCINet and visualized using NetDraw to produce a graphical representation of co-construction for each phase.
5. The participation matrices, were loaded into UCINet and analyzed, producing the three network centrality measures, in-degree, out-degree, and betweenness, for each student.
6. The researcher imported the set of centrality scores and the set of contribution scores for each case into SPSS and ran a regression model to examine the relationships. The model is discussed at length in Chapter 4.

Figure 4 presents a graphical representation of RQ2 data collection and analysis.

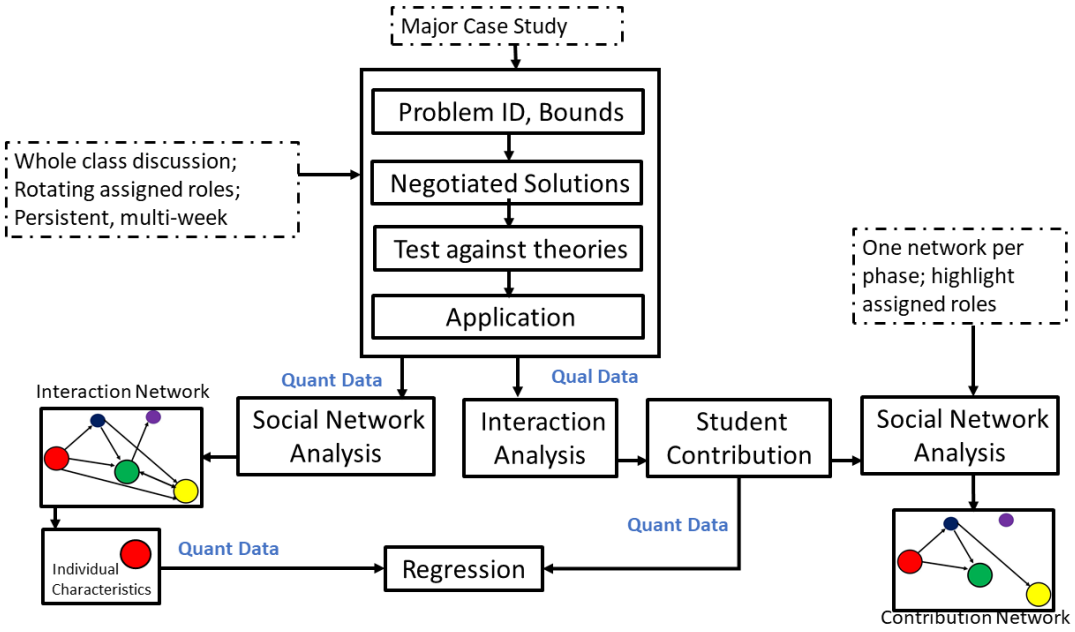

Figure 4. Graphical Depiction of Research Design for RQ2a and RQ2b

Ethical Considerations

This study takes place within a recently redeveloped graduate-level educational leadership course, which was conducted using a combination of face-to-face and online methods. Redevelopment was a joint effort between the course instructor and the researcher. The purpose of the redesign was to improve the interaction quality of the online portion of the course and to promote social knowledge co-construction. The course instructor assigned the researcher to serve as a teaching assistant during the course's inaugural execution. The researcher's teaching duties were limited to building discussion threads, providing detailed instructions, answering students' procedural questions and requests for time extensions, and for assigning and controlling the anonymity of student pair partners. The research goals of the present study were independent of course objectives. Care was taken to minimize student burden for supporting the study. Criteria for student success were specified and assessed by the instructor and were wholly de-coupled from research activity. To limit risk of participant coercion or any perception thereof, the researcher communicated the following conditions during the consenting process:

1. Participation was voluntary and other than the additional need for volunteers to complete the initial experience survey, course activities were to be identical for participants and non-participants.
2. Recruitment and consent were to take place such that the instructor would have no knowledge of which students consented to participate and which did not.
3. The researcher's duties as TA were limited such that the TA had no grading responsibilities of any kind.
4. The researcher will maintain student confidentiality by: referring to participants using arbitrary two-letter identifiers rather than their names, when reporting the study's results; and data derived from discussion board transcripts will be reduced to numerical and graphical representations, thus removing potentially identifying information.

Assumptions, Delimitations, and Limitations

In designing the study, the researcher made numerous assumptions concerning both the participant sample and the research settings. Practical considerations drove the researcher's choice of delimitations, each of which carry threats to validity and inferential power. Finally, the researcher had to accept certain inherent limitations and their inherent threat to the study's validity. Each of these considerations are examined here.

Assumptions

The researcher assumed the instructional activities of the research setting would successfully stimulate high-quality student-to-student interaction. Care was taken in the design of the course's online instructional activities to strengthen the credibility of this assumption. In addition, the study assumed there would be adequate variation in both power parity, operationalized using the survey, and patterns of student participation, operationalized using social network (node-level) characteristics, to draw meaningful inferences.

Delimitations

In this study, the three measures of student power used in the calculation of the power parity variable were limited to self-reports. The topical experience measure of power concerned a variety of educational leadership topics, each of which were relevant to one or more of the weekly case studies. The case studies related to these topics however, discussed both the topics and a specified leadership theory selected from the coursework. The very logic of this study would suggest that understanding of the theoretical component would be just as much a source of power as the topical knowledge from the students' experience. However, measuring this knowledge would likely create additional student reporting burden or require additional summative assessment, such as weekly quizzes. Additionally, while student experience with common topics grows slowly over time, student familiarity with a theory would likely increase dramatically during the week in which the theory was introduced and discussed. This would raise a significant reliability problem and introduce prohibitive timing challenges for any measurement. Despite the lack of practical means to incorporate relative mastery of leadership theory into the power measure, the researcher believed that potential power differences in the theoretical aspect of the case studies could be overcome. The students had adequate reference material at their disposal and the asynchronous nature of the discussion reduced the need to instantly recall key principles.

While expert power can be demonstrated through writing, referent power, that which is derived from a person's likeability, could not be accounted for, and is not guaranteed to be symmetric between discussants. However, discussions were kept anonymous until the final stage as a deliberate means to prevent bias, which might arise from pairings in which the partners share an affinity or lack of one. Despite this precaution, it is conceivable that impressions of

likability could be made simply from reading the work of another and the researcher saw no remedy for this potential condition.

Limitations

Although many studies of social knowledge co-construction using social network analysis have comparable sample sizes, such as Aviv et al. (2003) (n = 18, n = 19), Gunawardena et al. (2016) (n = 15), the small sample size of the present study (n = 19) limits generalizability of findings and more importantly, inferential power. If researchers converge on approaches to measuring student contribution to knowledge co-construction and methods of characterizing the resulting patterns of interaction, it may one day be possible to construct meta datasets collected across multiple studies. As second potential limitation of this study is the inability to control for other factors, such as work or family issues which might limit students' ability to fully engage in the co-construction process. A consequence of this is that it is plausible that in a given week, a student could be well paired with a discussant power-wise but ill-equipped to provide his or her efforts due to personal stressors, however temporary. In such cases, power parity, the variable of interest, could be eclipsed.

Conclusion

This chapter defined a proposed framework to improve the accuracy and fidelity with which student contributions to socially co-constructed knowledge artifacts are measured. It presented the study's two research questions and a rationale for the design, data collection, and analysis steps used to address these questions. The study's results are presented in Chapter Four.

Chapter IV: Results

As stated in Chapter One, the purpose of this concurrent mixed-methods design was to examine ways in which differences in experience levels, patterns of participation, and fulfillment of assigned roles shape the patterns and degree of social knowledge co-construction achieved by graduate student professionals enrolled in online educational leadership course.

It has been suggested that higher reasoning skills develop as we internalize our social interactions (Vygotsky, 1981). The online learning environment presents challenges to creating meaningful interactions (Palloff & Pratt, 2003; Simonsen et al., 2015). To meet these challenges, researchers have designed and tested methods to improve online interaction quality. Many of these efforts placed social knowledge co-construction at the apex of learning quality indicators (Aviv et al., 2003; Schellens & Valcke, 2007; De Wever et al., 2008; Hull & Saxon, 2009). Studies in these areas focused on different methods of instruction but did not heavily consider differences among students. As students negotiate meaning and co-construct new knowledge, their discussion is a "subtle political interaction that brings many aspects of power, motivation and persuasion into play" (Stahl, 2003, p. 5). Changes are negotiated, then validated (Stahl, 2002). Leading theorists (Piaget among them) allege that equality among discussants is needed to co-construct knowledge. However, this claim has yet to be studied in online learning environments. The first part of this study examined the relationship between power parity and social knowledge co-construction among pairs of discussants in an online graduate course.

While the product of interaction, that is the co-construction, may be shaped by endogenous factors, such as power parity, there still questions concerning the process of interaction through which knowledge is co-constructed. Social network analysis has been used to explore the relationship between social knowledge co-construction and patterns of interaction

through which constructions are made. These studies have produced mixed results. A potential explanation for this is the fact that there is no common framework for measuring individual contributions of social knowledge co-construction. The second research question in the present study proposed and demonstrated a rule set by which individual contributions to co-constructions could be attributed and using this ruleset, presented two cases through which these relationships could be examined.

Overview

By observing the content and patterns of academic discourse in a graduate-level, educational leadership course, one with a significant online component, the researcher hoped to explore several relationships regarding social knowledge co-construction. First, the researcher asked whether pairs of students whose level of personal experience with particular subject matter was relatively equal, would be more likely to attain greater levels of social knowledge co-construction in their academic discourse than pairs of students whose had disparities in their levels of experience. Next, the researcher asked what relationships might be observed between the patterns of participation in large group discussions and the contribution to social knowledge co-construction made by individual students.

Research Questions

1. What is the relationship between power parity and the level of social knowledge co-construction/negotiated meaning among paired-student threaded discussions in an online educational leadership course?
2. What relationships are seen in the patterns of student participation and the patterns of knowledge co-construction? This question is further decomposed.

2a. How does the network prominence of students performing specialized roles (facilitator, catalyst, search engine, summarizer) relate to the overall density of the co-construction network during each phase of discussion?

2b. What relationships are observed between student's network centrality (out-degree, in-degree, and betweenness) in the participation network and his or her contribution to knowledge co-construction?

Research Question 1

Because the study's two research questions were conducted using separate sources and methods, their participation, data collection procedures, analyses, and results are presented separately. This first section addresses research question 1.

Participation. All 19 enrolled students consented to participate in the study. The course instructor selected 11 educational leadership case studies from the book, *Case Studies in Educational Leadership* (Northouse & Lee, 2018). Each of these corresponded to chapter's in the course's primary textbook, *Leadership,* 8th ed (Northouse, 2019). Students were instructed to participate in 10 of the 11, giving them a free week of their choosing. With an odd number of students, full participation would have yielded 9 pairs per week for 11 weeks for a maximum sized data set of 99. The actual number of data points collected was only 67 and the number included in the study was $n = 66$. Three factors contributed to this reduction. First, to maintain the course schedule, the instructor established weekly deadlines of Monday, Friday, and Sunday for submission of the original post, the revised post, and the shared statement respectively. Students who failed to submit the original post on time could not be paired with another student as this would place unfair time constraints on the pair partner who submitted on time. In these cases, students were given a randomly assigned peer paper to inform their revision, but as the

procedure was not reciprocated, no shared statement could be generated, and these cases were excluded from the study. Second, one student, who consented to participate, did not complete the survey. Lacking power data, each of the participant's 10 paired discussions were eliminated from the study. Finally, a single case was eliminated because one pair partner mistakenly submitted her original post instead of her revision. This error was not detected in time to be corrected.

Data Collection Procedure. This section describes the data sources and methods used to collect and analyze data to investigate research question 1.

Paired Discussion Transcript. Each week, the researcher assigned each student a unique three-digit random number, produced using the RAND () function in Microsoft Excel. The list was then numerically sorted and starting at the top of the list, the researcher paired the first two, the next two, and so on. The last student on the list was left unpaired. The preliminary random pairing list was modified throughout the week to manage two conditions. First, late and missing submissions resulted in multiple students without a participating partner. In these cases, students were repaired with partners who had submitted. Second, after the first week, the researcher tracked the pairing history. When the randomizing function paired students who had been paired previously, the researcher shuffled the pairings to avoid duplication.

Once the week's final pairings were set, the researcher downloaded each student's preliminary post from the Canvas course transcript and referring to the Excel spreadsheet, replaced the student's name with their unique three-digit identifier. The researcher then e-mailed the de-identified posts to each partner with the following instructions:

> *Attached is your assigned partner post. Before Friday evening (11:59 PM), please read this post and append your own with at least a couple of sentences acknowledging*

differences between this post and your own. Consider how you might view the problem differently having read the thoughts of your classmate. Once you and your anonymous partner have turned in your revised posts, I will open a new discussion thread for you to discuss and draft your shared statement, which is due Sunday night. Let me know if you have any questions. Good Luck.

Once both pair members submitted their revised posts to canvas, the researcher created a single document containing the pair of original posts and revisions. He then opened a new discussion thread for the pair. The consolidated posts were included as an attachment. The pair were then notified, and the identities were revealed with an email message, a sample message reads:

I created your discussion thread on Canvas. When you click the assignment link 'Northouse & Lee Case Study 3.1 Shared Statements' scroll down until you see the thread with the header 'This thread is for <Name1> and <Name2>.' There I have attached a consolidated Word document with both of your revised posts in one file. You may work on the shared statement anytime between now and Sunday at Midnight. Please let me know if you encounter any trouble navigating to the space as this will help us fix any bugs for the rest of your classmates as well.

Each week, the researcher copied the shared discussion, appending it to the consolidated discussion document. The completed data item was then uploaded to Box for storage.

Survey Data. Results of the Qualtrics student experience survey were imported into Excel, where the researcher constructed a master table of power scores for each student in each case study. Recall that each case study had two or more issues facing educational leaders. The students were asked to rate their professional experience with each issue using a six-point Likert

scale. The student's power score for a given week was calculated as the average score all of all topics applicable to that week's case study. The power differential for each pair was then calculated, forming the set of data points for the independent variable, parity. As a secondary source of potential power differences, additional survey items asked participants how many years of experience they had serving as educational leaders and how many years they had working in education.

Social Knowledge Co-Construction Score Computation. Content analysis was deferred until all data were collected and the instructor closed the course for further submissions. The researcher evaluated the posts using the interaction analysis model. The posts were evaluated in order beginning with the first case study and the first pairing, that is the pair who had the two lowest three-digit numbers. To minimize confirmation bias, the researcher was careful to score each post before looking at the power differential for the pair.

Although not part of the co-construction score, the researcher read the discussion prompt and each pair member's original post. Original posts are the primary source of student opinion and lines of argumentation, but the ideas put forth in the original post are not considered co-constructions until the partner reacts to them. The researcher then read each sentence in the revised submission identifying statements of agreement, disagreement, negotiation, etc. as described in the interaction analysis model. The co-construction score was recorded based on the highest IAM-level utterance by either student in either the revised post or the shared statement. The following excerpts from a scored data sample illustrates the process used. Excerpts from Case 5.1, posts 919 and 922:

- Post 919: *I hadn't thought of Principal Hernandez quick reaction to the superintendent's dissatisfaction by putting two leadership chairs in charge was*

somewhat of an indication that he wasn't sure how to approach the situation. I just assumed that maybe he felt this was something he could delegate, to the leaders in the building, however, after reading this post I do believe that he was unsure how to achieve this goal.

The segment was evaluated as Level 3a, "negotiation of the meaning and use of terms", because after considering the partner's input, the participant broadens the application of the situational leadership model to tie together the antecedents and consequences of the case.

- Post 922: *After reading my colleagues response, I would definitely take a different approach. For example, I did not consider scheduling a planning and coaching session with both department leaders. Although they teach different subjects, reviewing the data collectively would provide more insight which would lead to more comprehensive planning.*

Similarly, these statements from the partner's revised post were evaluated as level 3b negotiation of argument weight. This is seen in the way the author puts greater weight on the value of the two teachers working together than on the fact that they teach different subjects and are concerned with different areas of standardized tests. Higher levels of co-construction were found in the student's dialogue as they crafted their shared statement.

- From student 922: *Your plan of action provoked me to reflect on our (my school) current practices when in regard to how we utilize department and/or grade level teams.*

This is an example of Level 4c as it tests the proposed construction against the conditions found in the author's professional environment. Evidence of the highest level of co-construction was seen the partner's subsequent statement.

- From student 919: *Reading your response certainly forced me to come out of teacher-mode and tackle my inside "leader". I hadn't considered that Principal Hernandez didn't really understand how to achieve this goal, because with my current position, as a classroom teacher, we seem to think administration has all the answers. Seeing this from the leadership point of view gave me insight on how true transformational leadership is modeled.*

This final segment achieved Level 4c by considering the solution in terms of the author's professional experience, and then Level 5c, as seen in the expression of changed perspective as a result of co-constructing the solution with the partner.

Excerpts from Case 8.1, posts 075 and 632:

- Post 075: *This leads to success within the school because she can express expectations, demonstrate tasks and behaviors, execute, and lead through development changes.*

Central to this case was the identification of the leader's dominant behavior from among the behaviors of the transformational leadership model. Post 075 made the case for individual consideration, while post 632 argued that idealized influence was dominant. This statement from the revised post was an attempt to convince the other that the case study's leader favored individual consideration. In this context, the statement is Level 2c "advancement of argument".

- Post 632: *As my peer has stated, Joan set exclusive requirements for her staff.*

Here the author advances her argument using her partner's own evidence. This too represents a Level 2c "advancement of argument".

- Post 632: *While individualized consideration is strongly evident with Joan's leadership style. I would still press her personal work ethic as the driving force for*

her success. If I had to choose a second most valuable attribute for Joan, it would be her use of her leadership team and strength of her coordinator.

Here, the participant acknowledges the validity of her partner's argument but negotiates the position that the weight of his argument is not as strong as the evidence in support of her own. This is a Level 3b "negotiation of weight."

- Post 075: *Idealized influence is a catalyst for individualized consideration because her tenacity allows her to commit to her staff in ways unquantifiable because she stays late, shows up early, and works on her days off.*

Here the participant integrates her position with the other's and proposes a relationship between the two positions. This is a Level 3d statement – "proposal of new statements embodying co-construction or compromise."

These two examples both illustrate how considering a peer's differing perspective can lead to exchanges promoting richer understanding of course content while adding nuance to one's own perspective. Not all paired discussions achieved this. In the next example, the participants converge quickly and without evidence of change. In the fifth weekly case study, students were asked to identify which of the four transformational leadership behaviors (Northouse, 2019) exhibited by the case's principal were most responsible for her success. Excerpt from Case 8.1:

- Post 434: *We both agree that Joan sets a great example for her staff by coming in early, staying late, and taking on extra duties. She leads, but delegates well. She is also willing to develop her staff. Joan recognizes the need to understand individual characteristics of her staff. Amy and I agree that Individualized Consideration is the main reason for Joan's success.*

- Post 531: *Thank you for your post. I completely agree.*

This example illustrates that not all discussions result in knowledge co-construction. If the goal of successfully promoting co-construction is considered worthwhile, it is worth understanding the factors that do so. Research question 1 in the current study explored the relationship between power parity among paired discussants and knowledge co-construction produced in their discussions. Study results are presented here.

Definition of Variables. This section defines the variables used in the regression model, their source, and their purpose in addressing Research Question 1.

- Score. The text of revised statements and final discussions were analyzed using the Interaction Analysis Model (IAM). The highest-scoring utterance from their combined discourse was recorded as the pair's knowledge co-construction score.
- Parity. This is defined as the difference in topical power score between the pair members. It has a maximum value of zero. Parity is measured with respect to the case study of the week in which the students were paired.
- Years in Education. The number of reported years the participant worked in the education field. This value was not used independently but was used to calculate to calculate differences between pair members.
- Difference of Years in Education. The difference in the Years in Education variable between paired participants.
- Years in Leadership. The number of reported years the participant served as an educational leader. This value was not used independently but was used to calculate to calculate differences between pair members.

- Difference in Years of Leadership. The difference in the Years in Leadership variable between paired participants.
- Weekly Discussion Mean Score. Not all weekly discussions are created equal. There is significant variation in the mean score for the class from week to week. Therefore, this variable was identified to control for the effects of weekly variation.
- Paired Student Mean Score. Not all students have the same propensity to achieve knowledge co-construction in threaded discussions. The pair mean is the mean co-construction score of each pair member over the duration of the course. It is used as a control variable.

Analysis. Using SPSS, the researcher modeled co-construction of the set of paired discussions using multiple regression. As seen in Table 4, the mean co-construction score for the course was just over 3.0. According to Gunawardena et al. (1997), the attainment of Level 3 is what distinguishes posts considered to contain evidence of unique social knowledge co-construction, while Levels 1 and 2 are considered foundational but not indicative of new construction. On average then, students participating in this study achieved the construction benchmark.

Table 4

Descriptive Statistics from Co-Construction Regression Model

	Mean	Std. Deviation	N
Score	3.005	1.0590	65
Parity	-1.0833	.86953	65
WkMean	2.977775	.5601454	65
PairMean	3.024345	.2571958	65
DifYrEd	6.31	3.897	65
DifYrLd	4.71	3.556	65

In the regression model, variables were tested for inclusion under the stepwise method, where variables were added and removed until those with the weakest correlations were removed. Entry criteria was set at initial significance levels of $p <= .05$ and model exit criteria was set at $p > .10$. Table 5 shows the Pearson correlations and significance levels of each variable tested for entry into the regression model. Significant bivariate correlations ($p < 0.5$, 1-tailed) with the dependent variable, *Score*, were found with parity and the two control variables, *WeeklyMean* and *PairMean*. Because the hypothesis explicitly proposed a positive relationship between co-construction score and parity, the researcher accepts all risk on the positive side of the distribution mean and thus use of a 1-tailed test is appropriate.

Table 5

Bivariate correlations among power measures, control variables, and co-construction scores

		Score	Parity	Weekly Mean	Pair Mean	DifYrs Ed	DifYrs Lead
Pearson Correlation	Score	1.000	.242	.504	.526	-.160	-.032
	Parity	.242	1.000	-.001	.131	-.088	-.299
	WkMean	.504	-.001	1.000	.148	.030	.011
	PairMean	.526	.131	.148	1.000	-.261	-.134
	DifYrEd	-.160	-.088	.030	-.261	1.000	-.066
	DifYrLd	-.032	-.299	.011	-.134	-.066	1.000
Sig. (1-tail)	Score	.	.026	.000	.000	.102	.400
	Parity	.026	.	.497	.148	.244	.008
	WkMean	.000	.497	.	.120	.405	.464
	PairMean	.000	.148	.120	.	.018	.144
	DifYrEd	.102	.244	.405	.018	.	.302
	DifYrLd	.400	.008	.464	.144	.302	.

Note. WkMean = weekly discussion mean score; DifYrsEd = difference of years in education; DifYrsLd = difference of years in leadership.

As seen in Table 6, the R-square value of the final model, $R^2 = .496$, indicates the regression model explains nearly half the variation in knowledge co-construction score. The

research variable, parity, makes a small but statistically significant contribution to the model's total explanatory power.

Table 6

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.526[a]	.276	.265	.9080	.276	24.058	1	63	.000
2	.680[b]	.463	.445	.7887	.186	21.484	1	62	.000
3	.704[c]	.496	.471	.7700	.033	4.048	1	61	.049

a. Predictors: (Constant), PairMean

b. Predictors: (Constant), PairMean, WkMean

c. Predictors: (Constant), PairMean, WkMean, Parity

The regression coefficients are presented in Table 7. Controlling for the effects of variation in weekly mean scores and mean student pair scores, the table of partial correlations in the final model indicate a small but statistically significant correlation between knowledge co-construction score and the research variable parity of $r = .249$. The significance level of the final model is $p = .049$. Therefore, the null hypothesis can be rejected in favor of the research hypothesis. Implications of this relationship and the relationship with the control variables are discussed in Chapter Five.

Table 7

Regression Model Coefficients[a], Partial Correlations, and Collinearity Metrics

Model		Unstandardized Coeff		Std Coeff			Correlations			Collinearity	
		B	Std. Error	Beta	t	Sig.	Zero	Partial	Part	Tol	VIF
1	Constant	-3.541	1.339		-2.644	.010					
	PairMean	2.164	.441	.526	4.905	.000	.526	.526	.526	1.000	1.000
2	Constant	-5.195	1.217		-4.269	.000					
	PairMean	1.899	.388	.461	4.900	.000	.526	.528	.456	.978	1.022
	WkMean	.825	.178	.436	4.635	.000	.504	.507	.432	.978	1.022
3	Constant	-4.664	1.217		-3.832	.000					
	PairMean	1.797	.382	.436	4.707	.000	.526	.516	.428	.961	1.041
	WkMean	.832	.174	.440	4.788	.000	.504	.523	.435	.978	1.023
	Parity	.225	.112	.185	2.012	.049	.242	.249	.183	.982	1.018

a. Dependent Variable: Score

Research Question 2

While Research Question 1 looked at factors influencing one-on-one social knowledge co-construction, Research Question 2 explored patterns of co-construction in larger group settings.

Data Collection Procedure. This section describes the data sources and methods used to collect and analyze data to investigate Research Question 2.

Major Case Study Discussion Transcripts. The data source for Research Question 2 consisted of discussion transcripts from two major case studies, in which the students participated in over two seven-week periods. The cases, chosen from the book, *Case Studies on Educational Administration*, 6th ed. (Kowalski, 2012), were selected based on the expectation that students would have a broad diversity of opinion concerning the subject matter and therefore, would be more likely to engage in discussion and debate. The first case, *School Improvement through Better Grading Practices* discussed the merits of implementing minimum grading policies as a means of raising student performance and reducing disciplinary incidents.

The second case, *Break the Rules and Pay the Price* discussed the use and efficacy of mandatory out-of-school suspension policies as a means of maintaining school safety and discipline.

As the discussions proceeded through phases as described previously, students rotated their roles between ordinary discussant and one four specialized participation roles. To prevent student burnout, each student was assigned 2 weeks off, one week in each case study, and was allowed to trade this time off with classmates to accommodate personal needs.

Transcript Analysis Using the IAM and the Ruleset. Analysis of the discussion transcript produced two social networks, the participation network and the co-construction network. The Interaction Analysis Model and the ruleset for measuring student contribution to knowledge co-construction were used in tandem to produce the co-construction network. The direct pattern of student-to-student posting was used to produce the participation network. This section provides data samples which describe the process used to build the two networks.

Results: RQ2a. This section presents the results of student participation in each of the two major case study discussions. Table 7 indicates the highest level of co-construction achieved in each case study during each of the four phases in which the cases were discussed. This provides a macro view of the evolution of student discourse over the course of each case study. Transcript samples are then provided for each phase in each case. These provide greater context as they illustrate the process through which students exchanged ideas and co-constructed knowledge. Sociograms are presented following each transcript to provide a phase-by-phase network view of co-construction while highlighting the contributions of students by assigned role.

Table 8

Highest IAM Level Achieved in Each Case by Phase (P)

	P1	P2	P3	P4
Major Case 1	3d	4c	4b	-
Major Case 2	2c	3d	4c	5b

Major Case 1: School Improvement Through Better Grading Practices. This section presents representative selections from the Canvas transcript of the first major case study. Data are presented by phase and include demonstrations of how the ruleset was applied to identify individual contributions to knowledge co-construction.

Phase 1. The student facilitator was instructed to write a discussion prompt that would encourage participants to discuss the nature of the problem. While the prompt solicited points of view about the suitability of the minimum grading policy for its desired end, it did not directly ask participants to describe the nature of the problem or identify root causes of the school's problems. In fact, it asked for preliminary solutions to resolve the case, something that was not supposed to surface until phase 2. The facilitator's prompt began with a problem-framing paragraph and ended with the following three questions:

- How do you think that changing the grading policy will increase academic success and decrease student behavior?
- Explain how you feel about a minimum grading policy and what are the implications associated with this policy? [*sic]*
- Also, from the three questions proposed above on implementation, which would you choose and why?

As students addressed the prompt, nearly every utterance was either a statement of fact or opinion. While some interaction analysis model users would evaluate and credit each of these as

IAM Level-1 discourse, consideration of these statements as contributions to social knowledge co-construction was deferred until students began to respond. As the rule set enforces, co-constructions measured in this study are products built through the process of student-to-student interactions, not constructivist changes which occur internally in the minds of participants.

To identify statements in original postings that should be credited, the researcher identified statements from subsequent responses that referenced earlier statements of fact or opinion. For traceability and audit purposes, the submission timestamp of referred statements was recorded whenever contributions were credited. An annotated excerpt from early phase-1 discourse highlights this.

> *Grades are true reflections of content mastery abilities, and indications of areas that could be improved. (ESPECIALLY early grades).*

This statement of opinion (Level 1a) triggers a response by the catalyst (CE Aug 27, 2019 at 2:29pm).

> *They are a way to communicate the strengths and weaknesses to the student and parents. According to what you are saying, a student who is below mastery at a 50% is failing just as much as a student who is below mastery at a 0%.*

This statement represents a Level 2a statement of disagreement in response to (PB Aug 26, 2019 at 9:05pm).

In this example, a participant with initials ‘PB’ makes a statement of opinion that triggers a statement of disagreement. The first participant is credited with 1 point for triggering the discussion, while the second received one point for the statement of disagreement and one point for advancing the co-construction to Level 2.

While I believe that it is important to set academic standards for a school, I do not think that it should be a top-down decision. Teachers need to take ownership of what is going on in their classrooms, therefore, any grading policy decisions should be made in a collaborative setting.

This is a Level 1 statement of opinion which triggers a level 3 negotiated response by the catalyst (CE Aug 27, 2019 at 2:39pm).

While I agree that changes to policies should happen in a collaborative setting, there are some situations in which leadership should be empowered to make executive decisions, even when they are unpopular with stakeholders. This sounds like a school in-crisis and it is an opportunity for the teachers and administrators to come together for solutions.

The two previous statements are an attempt to negotiate the relative weight the different points of argumentation should be given. The participant concedes the other's point about the value of collaboration (KC Aug 26, 2019 at 5:08pm) but gives primacy to the authority of school leaders. It is Level 3b and is awarded an additional contribution point for transitioning the idea to Level 3.

Note that in this example, it was not necessary to elicit a Level 2 statement of disagreement in order to make an attempt at negotiation. For scoring purposes, the first participant received a point for triggering a response and the respondent received one point for the Level 3 statement and one point for elevating the idea to a Level 3 co-construction. Although the idea advanced two levels, it was only awarded one transition point since there was only one transition.

The highest level of co-construction the class achieved in phase 1 was IAM Level 3d. The sociogram in Figure 5 reveals the associated patterns of contribution. Two noteworthy

characteristics can be seen in the diagrams, first, the network is denser compared with subsequent phases. This might be explained by fact that the facilitator solicited solutions before consensus could be reached on the nature of the case's problem. A greater number of lines of discussion is a plausible explanation for a greater chance that participants may disagree with one idea or another. The second item of note about the phase 1 sociogram is the relative centrality of the catalyst within this dense network. The catalyst in this phase engaged participants throughout the week, identifying sources of disagreement and spurring further discussion and refinement of ideas. Subsequent phase sociograms reveal a lack of catalyst activity and a less dense contribution network.

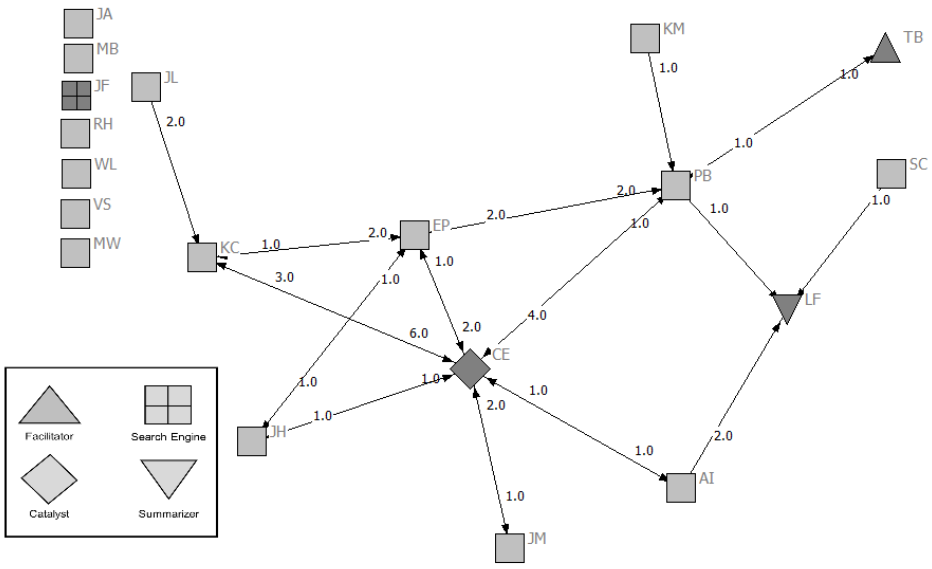

Figure 5. Phase 1 Co-Construction. Schematic depicts each student's social knowledge co-construction contribution during the first phase of the first major case study. Directed, weighted edges show both the diversity and frequency of interaction and the relative prominence of discussants and students assigned to specialized roles.

Phase 2. In phase 2, students were given two weeks during which they were to put forth potential ideas to resolve the case and to evaluate, improve, and consolidate them. As mentioned previously, the phase 1 facilitator opened the discussion to preliminary solutions. As a result, the phase 2 facilitator prompted the participants to begin evaluating and evolving ideas previously

put forth. Some participants continued to put forth new ideas as well, and some of these were debated as well. The following is an excerpt from the phase 2 facilitator's prompt.

> *We are now moving to phase 2 week 2. Our discussion will move to debating the strengths and weaknesses of each solution in order to achieve a single solution. Our group is relatively evenly distributed among the 3 options. This week will need to be heavy with discussion in order to reach a group solution.*

Although phase 2 was designed to evolve ideas to IAM Levels 2 and 3, some dialogue actually reached Level 4. In the sample below, discussants appear to take ownership of the discussion, engaging in negotiation, not simply to satisfy course requirements but to advance arguments on ideas about which they hold strong personal beliefs.

> *Leadership is about partnership, so I believe it is possible to get the teachers on-board without giving up the policy. I would do this by forming a school improvement council.*

This level 1 suggestion becomes a point of contention later for (VS Sep 5, 2019 at 7:18pm) where she argues against the idea of committees.

> *No committees. While a committee might work to do quantitative research, a committee is not the answer to get teacher input. A committee means a small group has a voice.*

These previous statements are level 2a and c as they challenge the idea of empowering committees (CE Sep 2, 2019 at 1:49pm) and they follow up with evidence to support the argument.

> *Wondering if you would consider tackling the inconsistency in the grading practices first, aside from the minimum grade aspect, as a way of helping the staff to "discover" a need to address the inconsistent grading practices - even if that just means weights of assignments, dropping lowest grades, etc.? Could this be a first step in leading the*

change that builds trust for the new principal and prepares teachers for the later philosophical debate about minimum grading?

This is level 3d negotiation. It concedes the argument of (VS Sep 5, 2019 at 7:18pm) but uses her rationale to suggest a preliminary course of action which has the potential to satisfy both points of view.

Focusing [on staff exploration of inconsistent grading] *would absolutely help build a more collaborative spirit and help make moving forward with a new strategy easier.*

This final statement is level 4a as it tests the proposed compromise against the participant's cognitive schema.

Phase 2 discussants reached level 4c knowledge co-construction. As seen in Figure X, the catalyst played a central role in the contribution network and this coincided with a relatively dense and connected network. In addition, noteworthy contributions were also seen from participants performing the other three specialized roles. The search engine injected current research into the discussion, furthering the debate and lending credibility to various positions held by discussants. Both the facilitator and the summarizer made contributions with the catalyst and other participants, reducing isolation in the network.

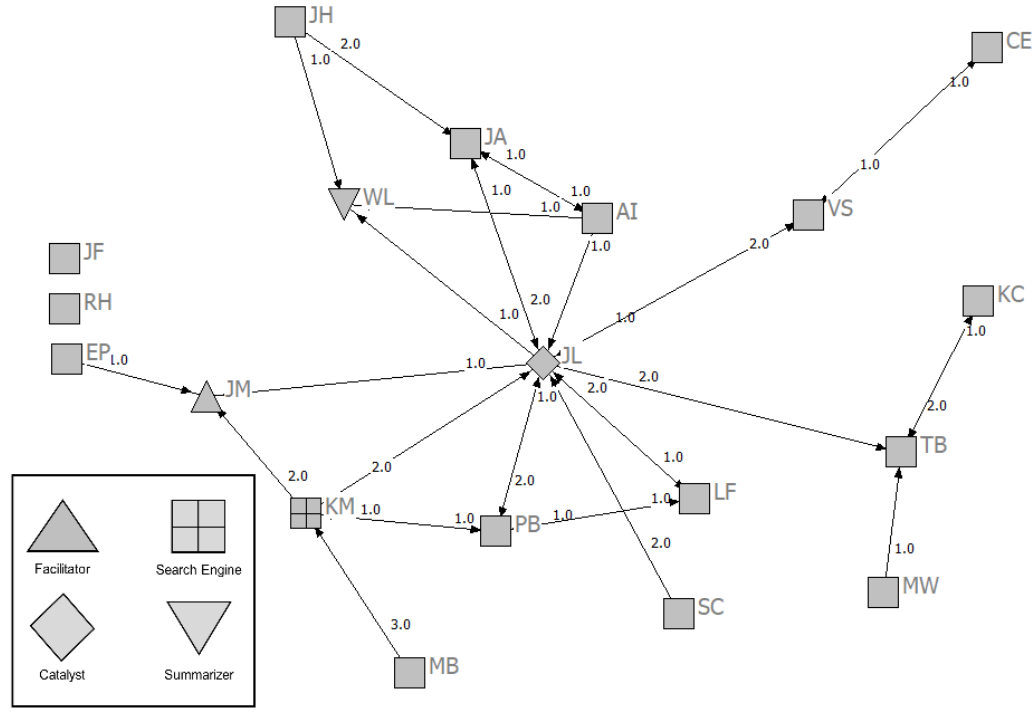

Figure 6. Phase 2 Co-Construction Schematic

As seen in Figure 6, the catalyst, depicted with a diamond shape, was central in the contribution network, directly engaging ten different students in knowledge co-construction. Further, the search engine participant made contributions with regular participants and those performing specialized roles.

Phase 3. The objective in phase 3 of the discussion was to further evolve the case study solution by testing negotiated solutions in terms of particular leadership theories discussed throughout the course. In terms of the IAM, phase 3 was meant to elicit level 4 statements which tested the co-construction against theory, evidence from the literature, or existing cognitive schema (Gunawardena et al., 1998). Evidence of co-construction was seen at all previously attained levels and this data were evaluated using the same rules and techniques as in previous phases. The core construction for the phase was the synthesis written by the summarizer and containing inputs from the class. The entire synthesis was dissected, and the sources of original

ideas were credited with contribution to the final co-construction. This excerpt from the phase 3 summary demonstrates how the summarizer integrated class contributions.

> *Throughout this discussion thread, the most common words and phrases related to understanding stakeholders' perspectives, developing team cohesion, and having a shared vision. Many of these ideas emanated from the need for the leader to work on his understanding of why his staff disagreed with his proposed solutions. All agreed that this leader would be more able to make changes if he utilized better social judgment skills and worked specifically on creating a team by beginning with seeing this problem from their perspective.*

In Phase 3, the catalyst did not fulfil her role. She posted two short statements, late in the week and as a participant, rather than as the catalyst. As Figure 7 reveals, there was a decrease in the number of contribution ties in phase 3 compared to phase 2.

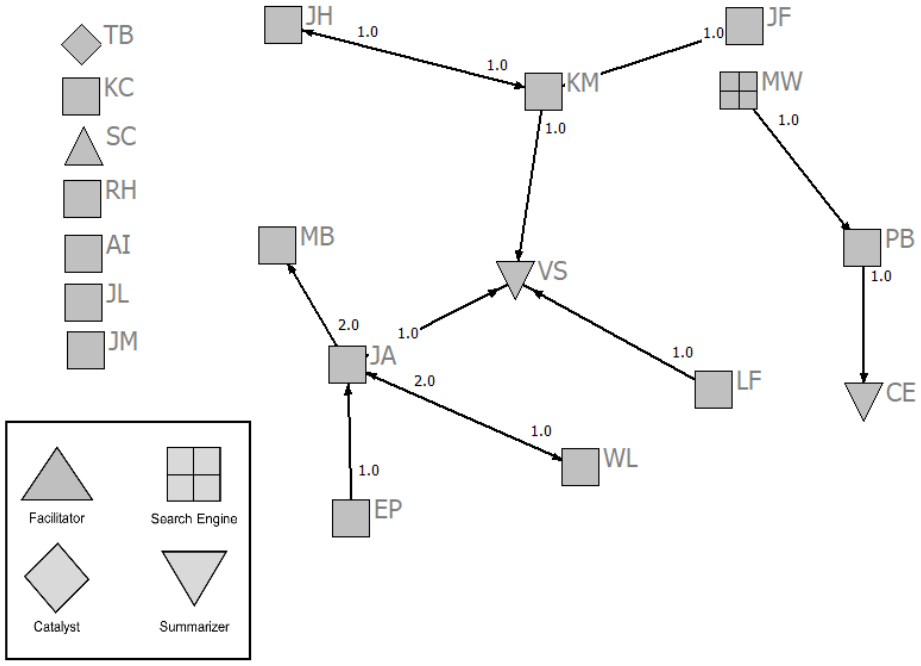

Figure 7. Phase 3 Co-Construction.

As Figure 7 shows, a lack of contribution on the part of the catalyst coincided with fewer connections among participants and weaker tie strength.

Phase 4. In the case study's final phase, students were asked to reflect on the case and identify what they learned through their participation and how their perspectives on the subject changed. In terms of the IAM, phase 4 was meant to elicit Level 5 statements. This phase did not have catalyst and search engine roles, and the participants were not prompted to engage directly with one another. Similar to phase 3, the summarizer was tasked to build the final co-construction, synthesizing inputs from the class. However, the student did not complete the task as instructed, submitting only her individual input instead. For this reason, phase 4 was not considered in the first major case study.

Major Case 2: *Break the Rules, Pay the Price*.

Phase 1. The facilitator provided a summary of the case and began the discussion with two questions.

> *Discuss the intended purposes and merit of student suspensions. What does the research on this topic reveal? What alternatives could have been used by Principal Sanchez to discipline Jimmy given the incident and his previous record of misbehavior?*

Unlike the previous case study, where the student serving as the discussion catalyst spurred the discussion forward by identifying sources of potential conflict, the phase-1 catalyst in this case did not engage participants until midweek, she engaged only the first two discussants, and the questions she raised did not elicit any response. Much of the interaction in this discussion phase consisted of statements of agreement, level 1b, and statements of support, level 1c. This trend can be seen in the following representative sample.

> *While I concur that safety is one of the primary roles of the school leader, if he is indeed seeking to support the welfare of "all" students he might need to consider the impact the suspensions have on the individual students receiving them, especially when the suspensions are related to non-violent and/or reoccurring behaviors.*

Level 1a statement of opinion which triggers a response from (PB Oct 13, 2019 at 6:30pm).

> *JL, I have to agree that this definitely sent red flags when I read the case as well. The term "all" students is dangerous especially when you treat them as "one". His terminology certainly signifies that he understands "all" to mean the students are all the same and should be treated equally, which I disagree. As you stated, I don't think he is taking a look at the students individually to assess their behavior and come up with a distinctive plan for their repeated offenses.*

Level 1b statement of agreement followed by level 1c support for position of (JL Oct 13, 2019 at 2:06pm).

The phase 1 summarizer produced a thorough synthesis capturing ideas from eight different participants. These ideas were traced back to the original respondents, who were credited with level 1 contributions. Examination of Figure X reveals a less dense and far less connected contribution network compared with phase 1 of the first major case study, where the catalyst made a substantial contribution.

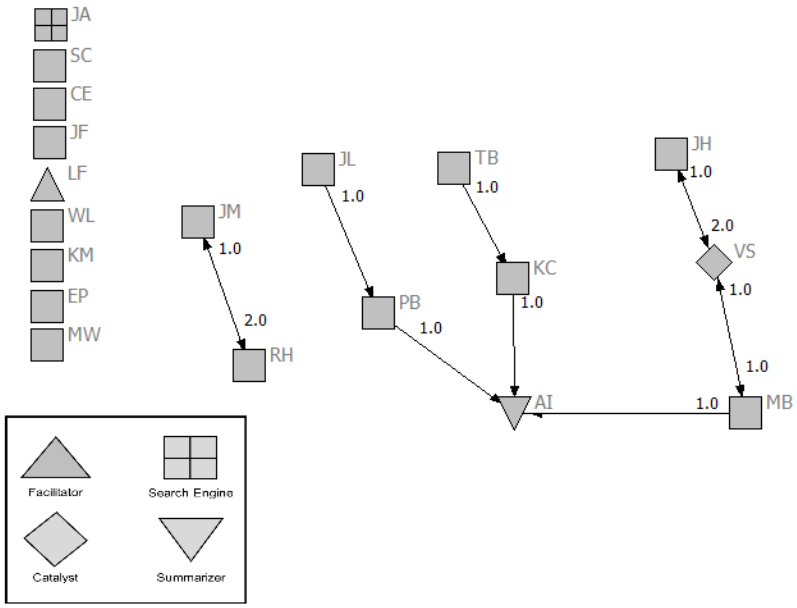

Figure 8. Phase 1 Co-construction, Second Major Case Study Schematic.

Phase 2. The facilitator prompted students to discuss various details of the case and present ideas. The phase 2 catalyst was more engaged, asking many clarifying questions, which are Level 1d. The dialogue remained mostly in Level 1. The summarizer developed a synthesis of solutions, and the ideas behind them were traced to the original respondents, who received credit for Level 1 contributions. In the second week, the facilitator prompted the participants to choose between two ideas. Rather than answer the question as an either/or, most participants put

forth hybrid solutions, which began to be debated. In the following data sample, the merits of using in-school suspension as an alternative to out-of-school suspension are debated.

> *In this case, however, I prefer that an effective ISS, which provides academic support, time to work on assignments and provides behavioral resources to keep students be implemented.*

This is a new suggestion to add to the level 1c supported statement of (JM Oct 13, 2019 at 3:16pm.)

> *In-school suspension is not a better option than out-of-school suspension.*

[Level 2a statement of disagreement directed at (JA Oct 22, 2019 at 8:48am) for his suggestion favoring ISS over OSS.]

> *I do think ISS can be effective but only under specific circumstances and only if being in ISS is truly a deterrent for students. Other than removing a disruptive student from a specific classroom for a specific time (not all day) maybe to keep an issue from escalating, I cannot think of the value of ISS.*

[These statements are negotiation of weight, level 3b.]

As shown in Figure 9, both the catalyst and the summarizer held central positions in the co-construction network while the search engine, who enhanced the discussion with outside sources, promoted further contribution from participants.

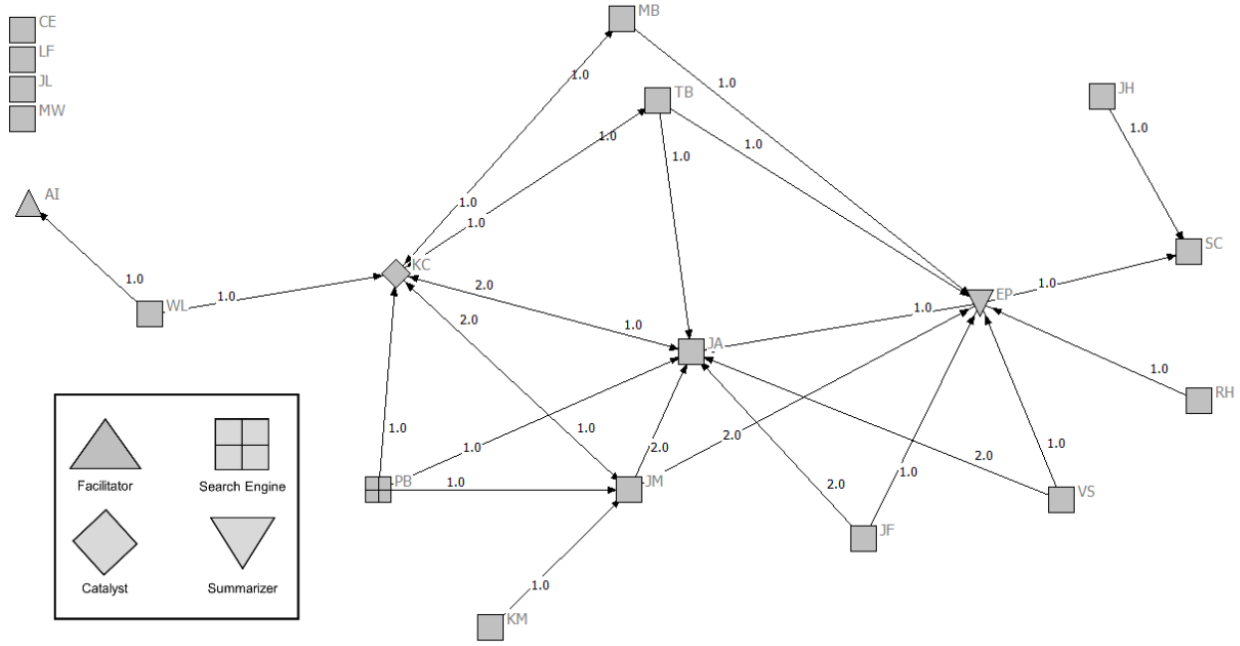

Figure 9. Phase 2 Co-construction, Second Major Case Study Schematic.

Phase 3. To discuss proposed solutions in light of theoretical concepts from the course materials, the facilitator prompted the students do discuss proposed solutions in terms of the behavioral approach to leadership (Northouse, 2018).

> *Using the behavioral approach, explain how as the leader, would implement these changes. For instance, explain how you would ensure that your followers feel more comfortable and how you would use task behaviors to facilitate goal accomplishment.*

In the following example, a supportive, student-centered ISS solution was put forth and described using tenets of the behavioral approach model.

> *I would provide some training for the ISS person and ensure they understand the goal we have for students who are filtered through their class and their purpose as ISS coordinator. We would work with the counselor to set up a schedule of check in times for these students to see the counselor and times for the needs or concerns. This would make them feel cared about and give that extra attention these students may need.*

This last sentence is an actual test of the theory and posits cause and effect. It is Level 4b and as the first test of this idea, it is awarded an extra point for transitioning to Level 4.

This phase saw limited contribution from the catalyst. Further, the summarizer enumerated the list of ideas put forth by the participants, but she did not attempt any synthesis nor identify any connections among the various contributions. It is not surprising to see that Figure 10's depiction of the network of phase 3 contribution is relatively sparse and disconnected, with most of the interaction occurring between the facilitator and the discussants.

Figure 10. Phase 3 Co-construction, Second Major Case Study

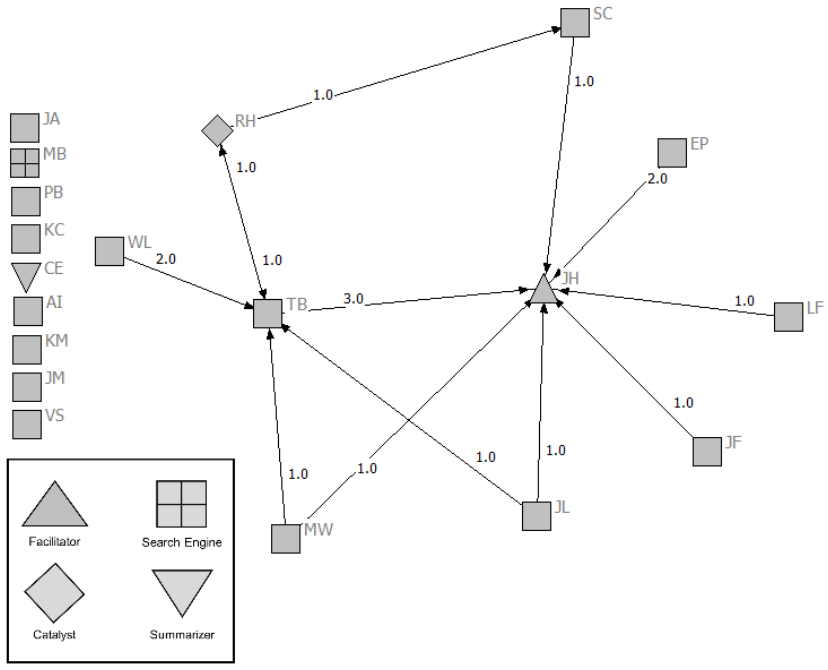

Figure 10. Phase 3 Co-construction, Second Major Case Study. Schematic.

Phase 4. The phase 4 facilitator prompted students to reflect on their participation in the case. It was designed to illicit Level 5 statements.

Identify at least two lessons learned from the engagement of this major case study.

Explain how the aforementioned lessons inform considerations for professional practice as an instructional leader.

While there was little interaction in this phase, the summarizer produced a detailed synthesis, building a final co-construction with Level 5a and b statements. The summary incorporated statements from eight different students, who were credited with Level 5 contributions.

As these annotated transcript samples have shown, social knowledge co-construction evolved as the discussions moved through the phases. Social network diagrams reveal the patterns of co-construction associated with each phase and illustrate the extent to which students holding specialized roles contributed to these constructions.

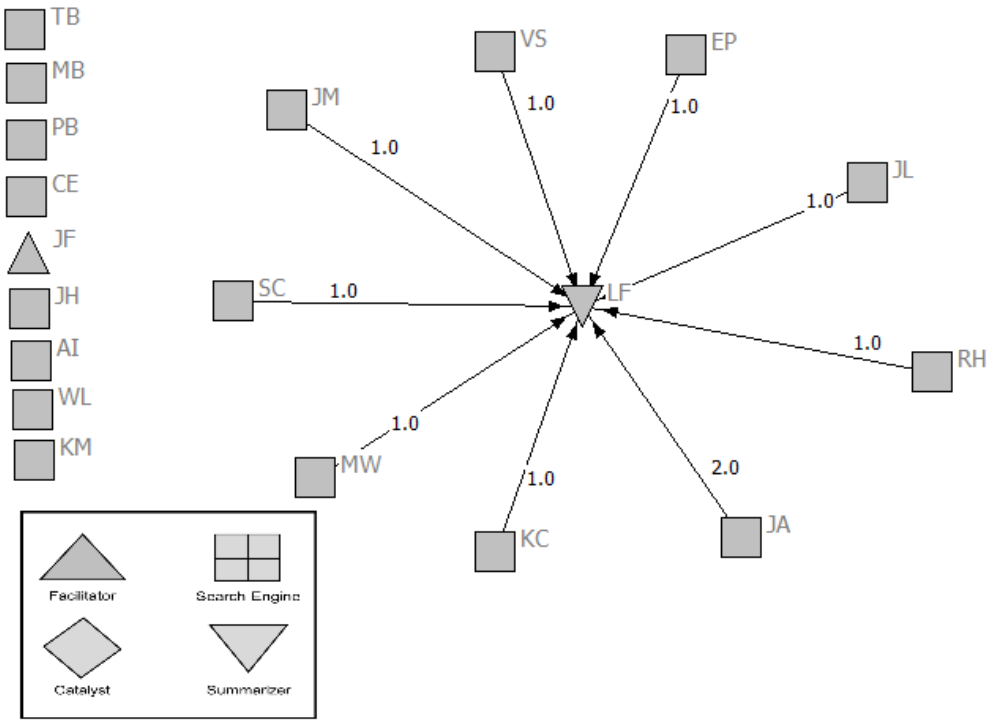

Figure 11. Phase 4 Co-construction, Second Major Case Study Schematic. Note that in phase 4 only facilitator and summarizer roles were assigned.

Phase 4 asks students to reflect on their participation in the case study rather than debate elements of the case. As a result, the patterns of co-construction center on the summarizer, who synthesizes the class's collective lessons learned from the participants' inputs.

Results: RQ2b - Contrasting Participation and Co-Construction. Student participation was operationalized in three ways commonly used in social network analysis. The first of these is out-degree centrality, which represents the number of posts made by the student. The second is in-degree centrality, or how many instances a student received posts. The third measure, betweenness centrality, is bit more complex. Betweenness centrality is a measure of how information flows through a particular student. In graph theory terminology, it is a measure of how often a given node (student) lies along the shortest path between every pair of nodes in the graph). Social network analysis studies consider individuals with high betweenness centrality to be information "filters," agents through which ideas pass (Borgatti et al., 2018, p. 201).

To analyze the relationship between the participation and co-construction networks, the researcher first created the participation network from the course's Canvas transcript, logging each post between students. The matrix was updated with each post such that the element $M(i,j)$ was incremented each time student i posted a statement to student $\boldsymbol{j}$. When plotted, directionality of edges between nodes follows the directionality of the post, this is, from i to j. The initial discussion prompt and the initial responses were excluded from this procedure as this would incorrectly bias the matrix in favor of the facilitator, when in fact the discussion prompt was directed at the class collectively and not intended as an individual interaction between a pair of students. The co-construction matrix was created using the procedures outlined in the rule set. Elements of the co-construction the matrix were incremented with each point earned under the ruleset. See Chapter Three for a review of the ruleset.

Model. To simplify presentation while preserving information, data from the two cases were combined into a single multiple regression model with a time-invariant variable, case, used to capture differences between the two case studies.

UCINet was used to calculate the three network centrality measures of each of the 19 participants in each case. The co-construction matrix of each case was summed row-wise to produce the co-construction scores for each participant. This resulted in a dataset of $n = 38$ quintuples $\{I, O, B, S, c\}$, where I , O, and B are continuous variables representing normalized in-degree, out-degree, and betweenness centralities, S is a positive integer representing the co-construction score for the participant in a given case and c is a binary flag to indicate the case to which the data belong.

SPSS was used to model the regression with the co-construction score as the dependent variable and the three centrality measures and the case indicator as the independent variables. Independent variables were tested using the *stepwise* method, which retains only those variables with statistical significance and unique contribution to the model's explanatory power. As seen in Table 9, out-degree centrality was the only participation measure retained in by the model. The case indicator was also found to be significant, indicating a substantial difference in mean co-construction contribution between the two cases.

Table 9

Regression Model Coefficients

Model		Std. Coefficients			Correlations			Collinearity	
		Beta	t	Sig.	Zero-order	Partial	Part	Tol	VIF
1	Const		2.225	.032					
	nOutd	.691	5.743	.000	.691	.691	.691	1.000	1.000
2	Const		3.874	.000					
	nOutd	.719	6.749	.000	.691	.752	.717	.994	1.006
	Case	.357	3.350	.002	.301	.493	.356	.994	1.006

Note: Std. = standardized; Tol = tolerance; VIF = variance inflation factor; nOutd = normalized out-degree centrality.

The model summary, presented in Table 10 indicates that out-degree centrality accounts for just under half the variation in knowledge co-construction, $R^2 = .478$. The case indicator

explains an additional 12.7% of variance in knowledge co-construction with $R^2 = .605$ for the final model.

Table 10

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.691[a]	.478	.464	2.663	.478	32.977	1	36	.000
2	.778[b]	.605	.582	2.350	.127	11.222	1	35	.002

a. Predictors: (Constant), normalized out-degree centrality

b. Predictors: (Constant), normalized out-degree centrality, case indicator

The two cases had a significant difference in total contributions to knowledge co-construction between them. A structural look at the differences between the two cases may help explain this result. The second major case differed from the first case in several important ways. The most obvious difference is the fact that the phase 4, the summarizer completed a synthesis of class lessons learned, elevating the overall class co-construction. The phase 4 summarizer failed to perform this assigned task in the first case study and as a result phase 4 yielded no additional contributions. A second difference between the two major cases was the level of contribution on behalf of participants playing the catalyst role. In the first case, the phase 1 catalyst was strongly engaged, while the phase 3 catalyst was not. In the second case, the phase 1 catalyst was disengaged while the phase 3 catalyst was moderately disengaged. With only two cases, it is not practical to draw conclusions about how catalyst impacted co-construction. For this study, we can only offer two cases, the differences observed, and the observed relationship between participation and co-construction within each case.

Summary

The researcher conducted this mixed-methods study to explore two distinct but related questions concerning social knowledge co-construction in an online, graduate-level educational leadership course. First, the study explored the relationship between power parity among paired discussants and the level of social knowledge co-construction they attain. Next, a framework was introduced to measure individual contributions to social knowledge co-contributions in large group discussions. Using this framework, the researcher used social network analysis to explore patterns of knowledge co-construction in phased discussions in which students performed assigned, specialized roles. The patterns of co-construction were then contrasted with the general patterns of participation to examine relationships between student's network centrality and their contribution to knowledge co-construction.

The results presented in this chapter were based on analysis of quantitative survey data and discussion board transcripts. To address research question 1, the researcher used the interaction analysis model to measure the level of knowledge co-construction found in the online discourse of 65 unique pairings of 18 students and a survey of student experience with various contemporary issues. Variations were seen from one case to the next and between pairs of students whose members consistently achieved high levels of co-construction. A multiple regression analysis revealed that after controlling for these two sources of variation, a small but statistically significant relationship between power parity and knowledge co-construction was revealed.

Transcripts from the course's two major case studies served as the single data source of the second research question. Participants completed the case studies over two consecutive 6-week periods. Again, the interaction analysis model was used to measure levels of knowledge co-construction, but this time, the researcher followed a pre-defined ruleset to measure each student's contribution to the class construction. Specialized roles were assigned to students and the student-facilitated discussion was conducted in four phases spanning 1-2 weeks each. Research question 2a

was addressed graphically. Sociograms were created for each of the two cases four phases and students assigned particular roles were differentiated from other participants. Patterns revealed in the diagrams suggest the importance of the catalyst role, both in direct contribution to social knowledge co-construction and in overall density of the contribution network. Research Question 2b was addressed using a regression model to explore the predictive power of participation to detect knowledge co-construction. Participation was operationalized using three common social network centrality measures: in-degree, out-degree, and betweenness. Regression analysis revealed that out-degree centrality accounts for nearly half of the variation in student contribution to knowledge co-construction. The other two centrality measures added no additional explanatory power. However, differences between the two cases provided additional variation, the implications for which are discussed in Chapter Five.

While the results presented in this study are not generalizable, it is hoped that they may provide the impetus for further exploration of the relationship between power parity and social knowledge co-construction. It is further hoped that this study's attempt to quantify individual student contributions to social knowledge co-construction may be refined and simplified in future work so that future studies in distance learning that leverage both social network analysis and the interaction analysis model may be conducted using more standardized measures than have been presented in the past. Chapter Five follows with a discussion of these results in relation to relevant literature as well as implications for further research and for practice.

Chapter V: Conclusion

This final chapter presents a summary of the study and discusses its findings. The results of each research question are discussed separately in relation to recent and relevant studies from the literature. Findings concerning the relationship between power parity and knowledge co-construction among paired discussants are presented first, followed by the patterns of co-construction associated with role-based, phased discussions of larger student groups. The relationship between student participation and contribution to social knowledge co-construction is discussed next. Ideas for future research follow the presentation of findings and finally, ideas for how this study might inform practice in online instruction complete this chapter.

Summary of the Study

The purpose of this concurrent mixed-methods study was to extend understanding of how individual roles and relationships of power, existing between adult students, influences their ability to co-create knowledge and shape the patterns through which knowledge is constructed in an online learning environment.

The conceptual framework which guided this study is grounded in the idea that when studying the highly contextual subject matter found in professional practice, the co-construction of knowledge among richly experienced persons represents a vital component of learning. The framework is built in the constructivist tradition and inspired by Piaget's cognitive constructivism (1967), Vygotsky's social constructivism (1986), Papert and Harel's constructionism (1991), and negotiated meaning theory from Baker (1994) and Stahl (2003). It posits that co-constructed knowledge is distinctive because it embodies the unique experiences of those who construct it. While the artifacts of construction may be unique and their application perhaps limited contextually, the process of co-construction reliably improves the quality of

knowledge held by individuals. The online learning environment, which is de-constructed in a four-frames analysis (Bolman & Deal, 2010) in Chapter Two, provides a fertile setting for student professionals to co-construct knowledge. Social network analysis and the interaction analysis model (Gunawardena et al., 1997) are two complementary tools which have been used successfully by researchers to study knowledge co-construction in this environment. Still, questions remain concerning factors that shape knowledge co-construction and the patterns which result. Among these factors are individual roles and relationships of power, existing between adult students. Understanding how these factors influence student success at co-constructing knowledge and shape the patterns through which knowledge is constructed is vital to promoting social knowledge co-construction in online learning.

Chapter Three developed the study's line of inquiry and presented the rationale for its design. To satisfy the study' purpose, two research questions were asked.

1. What is the relationship between power parity and the level of social knowledge co-construction/negotiated meaning among paired-student threaded discussions in an online educational leadership course?
2. What relationships are seen in the patterns of student participation and the patterns of knowledge co-construction? This question is further decomposed.

    2a. How does the network prominence of students performing specialized roles (facilitator, catalyst, search engine, summarizer) relate to the overall density of the co-construction network during each phase of discussion?

    2b. What relationships are observed between student's network centrality (out-degree, in-degree, and betweenness) in the participation network and his or her contribution to knowledge co-construction?

The researcher chose a convergent mixed methods design (Creswell & Plano-Clark, 2018), which was discussed in detail in Chapter Three. To answer the first research question, transcripts from paired discussions were converted from qualitative to quantitative data via the interaction analysis model (Gunawardena et al., 1997). Once converted, these data were related to power parity using a multiple regression model. For RQ2a, transcript data from whole-class discussions were transformed using the interaction analysis model in conjunction with a defined ruleset to identify individual contributions to knowledge co construction. These quantitative data were analyzed relationally using social network analysis. Patterns of interaction were graphed, highlighting the prominence of students assigned to specialized roles and the evolution of contributions over time. To address RQ2b, participation was contrasted with social knowledge contribution at the individual level.

Results from RQ1 came from analysis of $n = 64$ paired student discussion threads and revealed a small, though statistically significant, bi-variate correlation ($r = .242$, $p = .049$) between power parity and social knowledge co-construction score. Controlling for the effects of variation in the class' weekly mean score and in the mean score of pair members revealed a slightly higher partial correlation of $r = .249$. Results from RQ2a were derived from the patterns of participation and contribution of $n = 19$ students. They suggest a positive relationship between the contribution of students performing the catalyst role and the overall density of the contribution network for the first three of the four phases of discussion. Results from RQ2b suggest a positive relationship between the relative number of posts (normalized out-degree centrality) made by a student and the student's contribution to knowledge co-construction. No significant relationship to co-construction was found in the relative number of received posts (normalized in-degree centrality) or the student's relative prominence as an information broker

(betweenness centrality). The remainder of this chapter will relate these findings to the recent literature and will discuss implications for research and for practice.

Discussion of Research Question 1

Findings of Research Question 1 Related to the Literature

As discussed in the review of literature, theorists such as Piaget, as noted by Conrad & Donaldson (2004), Gunawardena et al. (1997), Baker (2003), and Stahl (2003) have suggested that social knowledge co-construction and negotiation of meaning depend, in part, on equality among participants. A thorough literature search revealed that to date, no empirical studies have attempted to validate this notion. Borrowing from Eisen's (2011) negotiation model, the researcher operationalized equality in terms of power parity, specifically, expert power, the credibility one demonstrates as a result of one's relevant experience (Northouse, 2019), and examined the relationship between power parity among paired discussants in a online, educational leadership course and the level of social knowledge co-construction they achieve, as measured using the interaction analysis model (Gunawardena et al., 1997).

Power Parity. A few recent studies have looked at the role of power in contexts, such as public resource management, in shaping knowledge construction and meaning (Jean et al., 2018; Owusu-Agyeman & Fourie-Malherbe, 2019; Twalo, 2019). However, no studies have examined knowledge co-construction in the online learning environment through lens of power parity. As a consequence, there is no baseline in the literature with which to compare the results of the present study. Still, an acknowledgement that socially dynamic and complex activities, such as learning, are influenced by a multitude of factors is helpful in explaining the modest results found here. As detailed in Chapter Four, evidence from this study suggests that once controlling for structural causes of variation, there is a small but statistically significant relationship between

power parity and the level of social knowledge co-construction achieved. Given the complexities of learning and social interaction, it should not be too surprising for a single factor to have limited explanatory power, even when controlling for other factors. However, a critical look at the study's control variables, the class' weekly mean co-construction score and the paired mean score, point logically towards subfactors that may have been influential in the level of observed knowledge co-construction.

Variation in Weekly Mean Co-Construction Score. In each of the 10 weeks in which students participated in paired case study discussions, significant variation was observed in the class' average co-construction score with an observed mean of just over 3.0 out of 5, and an observed standard deviation of 0.524. Score means ranged from a low of 2.325 in week 9 to a high of 3.743 in week 6. According to Gunawardena et al. (1997), discourse reaching IAM level 3 and above is considered evidence of knowledge co-construction while discussions at IAM Levels 1 and 2 are foundational but not indicative of new construction. On average then, students participating in this study achieved the construction benchmark each week. While the mean score indicates participants co-constructed knowledge on a consistent basis, it is important to ask why in some weeks the mean discussion score failed to reach level 3 and in other weeks, this threshold was exceeded. Evidence from the literature suggests a review of the course structure may reveal potential explanation for this variance.

Program Workload and Flow. Recall from the review of literature in chapter 2 that social distance, an inhibitor of online learning, includes among its causes, rigidity, which is described primarily as a lack of flexibility in workload and deadlines (Freedman et al., 2003). Recall that the study participants are fulltime educators, following a demanding cohort model, which together place competing demands on students' time. Most cohort members were enrolled

together in the same three graduate-level classes. The cohort's face to face meetings generally took place over three weekends, during which students spent more than twelve hours in class and were asked to attend other program meetings and presentations as well. The combination of these demanding weekends and the ebb and flow of assignments from the participants' other classes, could easily produce crunch times, where students may have had to balance efforts across competing demands. The course's assignment schedule may have been too rigid and unable to accommodate surges in student time, leading to potentially reduced levels of effort during some discussions. If the instructional methods employed in this study are repeated, flexibility should be increased to the extent possible and the demands of meaningful participation carefully balanced against underlying educational objectives (Manning & Smith, 2018).

Instructional Design. As students engage in case studies, they naturally bring with them their relevant experiences and opinions. As they draw from their experience, they apply course concepts in ways reflective of this experience. Terms and definitions from the course materials are given proposed shape and context. Instructional design provides the structural mechanisms through which interactions occur. In this study, the structure of the weekly paired discussions was designed so that students needed to draw on both theoretical leadership concepts from the course and current issues in K-12 education. The extent to which each case study successful in promoting knowledge co-construction may have been influenced by several factors including personal interest, context for engagement, and the uncertain choices of a dilemma.

Interest. As Ko and Rossen (2004) note, diversity among students will result in different interests, which should be taken into account in the design of online learning. Because each case was chosen independent of students' interests, it follows that some topics were more or less interesting to students, both individually and in aggregate.

Context for engagement. Although the case study prompts solicit ideas for case resolution, each student did so first on her own. The context for engagement was set as peers reviewed the propositions of their classmates. In some cases, students experienced dissonance as they came across an interpretation incongruent with their own. This sets the stage for negotiation of meaning (Gunawardena et al., 1997). However, in the absence of observed disagreement, the context for interaction was reduced. The choice to limit interaction until after first opinions were rendered was made to encourage critical reflection of self and peer writing. However, a collaborative approach to solution creation could have provided more opportunities for knowledge-co-construction (Conrad & Donaldson, 2004).

Lack of contention. The weekly case studies were drawn from *Leadership Case Studies in Education* (Northouse & Lee, 2019) and were designed to align with the chapters in the primary course text, *Leadership, 8th ed* (Northouse, 2019). The case study authors maintain "they are not cases that you can answer quickly but are reflective of the kind of leadership issues educators demand every day" (Northouse & Lee, 2019, p. 5). Despite the assertion of the case study authors, in some cases, particularly case 10 and case 11, students showed little variation in their responses and subsequently exchanged statements of agreement without uncovering dissonance. It should be noted that unlike the major case studies, which were detail-rich, the weekly case readings averaged only three pages in length. The brevity of the case studies may have restricted differing viewpoints to major conceptual disagreements rather than allow for exposure to potential points of contention. Cases where co-construction was lower tended to be those where students quickly converged around the idea that one or more of the case's characters were right and another was wrong. This dichotomization, which was observed in some cases more than others, potentially explains some of the variation in the weekly mean score.

Variation in Student Mean Scores. In addition to variation in the class' mean co-construction scores from week to week, there was considerable variation at the individual level, where some students were more often part of a high-scoring pair than others. Three possible explanations for this variation are found in the literature: effort, level of comfort engaging in co-construction activities, and personal challenges.

Effort. Knowledge construction requires effort and students not all students are accustomed to doing heavy mental lifting (Palloff & Pratt, 2001). They argue further that the instructor should play an active role in promoting critical thinking and other co-constructive behaviors (2001). This point of view is shared by Ringler et al. (2017), who say "the role of the instructor is critical to keeping students motivated to participate in ongoing discussions" (p. 17).

Level of Comfort Engaging in Co-Construction Activities. Simonsen et al. (2015) note that students' resistance to collaboration can be daunting. Researchers have offered some explanations for this. In their research on social distance in online learning, Freedman et al. (2003) suggest that students may be hesitant to state and defend their positions because of perceptions that they are not as capable as their peers. In addition, many students lack cooperative learning experience and may need a push to help them break out of the "competitive learning mode" to which they are accustomed (Conrad & Donaldson, 2004, p. 8). Wake and Bunn (2015) add that "learners who were raised in the high stakes testing environments resulting from NCLB may have become accustomed to more didactic methods and can encounter difficulty in adapting to new teaching and learning methods" (p. 42).

Personal Challenges. As noted when discussing power parity in this study's limitations, the ebb and flow of demands and stressors in students' lives could create instances where in a given week they could find themselves optimally paired for social knowledge co-construction

but unable to devote the time necessary to fully engage the required critical thought and reflection. Likewise, it is possible that for some students, personal challenges persisted for the entire semester resulting in lower levels of engagement. Such instances could explain some of the variation in mean student discussion scores.

Implications for Research

Research Question 1 revealed two potentially significant implications for the future of social knowledge co-construction research. The first of these concerns measures of power parity. The second had broader implications as it brings to light additional pitfalls of attempting to quantify social knowledge co-construction.

Measuring Different Elements of Power Parity. Although this study appears to be the first to attempt to measure power parity in the co-construction of knowledge, it was unable to account for and control all relevant sources of power. Each week, the case study discussion was grounded in a single leadership theory, which the student had been assigned to read during the week prior. Each case explored contemporary issues in educational leadership, which the students analyzed using the framework of that week's leadership theory. This created two dimensions of expert power: theoretical and topical (French & Raven, 1962). Expert power in the theoretical dimension was derived from mastery of the recently introduced leadership theory. The topical dimension was derived from the subject matter and context of a case study, such as a rural school setting and an issue of bullying. The case study prompt was designed to address the leadership theory of the week, while discussing the details associated with the case. While the pre-course survey provided a measure of topical experience with which students' expert power levels could be differentiated, no means were available to differentiate student mastery of the weekly leadership theory. Even if quizzes were administered prior to beginning each case study,

they would not account for any additional mastery resulting from participation in the case study itself. As a result, the case study was analyzed with at least two sources of parity while only one of these were measured. Future research in this area will require ways to either measure both sources simultaneously, and to at least control for one while measuring the other. One possibility would be for the instructor to evaluate initial posts for demonstrated content mastery alone. This need not result in much additional effort on the part of the instructor. In this class for example, the instructor graded the post holistically. If a rubric were used, the total grade could be a composite of relevant factors valued by the instructor with content mastery being one factor.

Quantifying Social Knowledge Co-Construction in Paired Discussion. Analysis of paired discussion transcripts demonstrated the potential to achieve high levels of co-construction along a narrow line of inquiry representing only a small portion of the entire case. An example of this is found in the shared statements of paired posts 199 and 282 where a participant made a clear Level 5 statement of changed perspective and directly attributed this change to the discourse with his partner. The change, though explicitly stated, concerned a relatively minor element of the case study. This raises an important question concerning how co-construction within a post is scored relative to other posts. Is it more desirable, for example, that student pairs reach the highest level possible on a single idea than for them to demonstrate multiple, substantive instances of new construction at lower levels? As it has been applied here and in previous research, the IAM favors the latter over the former. While this represents methodological reality, it is not clear whether it is justified epistemologically.

Implications for Practice

As described in Chapter Two, efforts to promote social knowledge co-construction is but one element of strategy for successful learning in the constructivist's arsenal. Discussing the benefits of peer tutoring, Whiteside et al. (2017) note that pair interactions where one member has more extensive experience than the other can aid the development of both. Arguably though, since the interaction is asymmetric with respect to give and take, the net developmental gain cannot be assumed to be equal for each member. Nonetheless, educators must be mindful of how the benefits and challenges of various learning modalities may affect students differently and should plan a variety of instructional activities in their learning experiences.

This study presented evidence that student differences in experience levels, with respect to a topic of discussion, may factor into the degree of co-construction a pair of students will achieve when discussing or debating highly contextual subject matter. Depending on the instructor's purpose, it may be prudent for instructors to consider this fact when building discussion prompts for online discussions. While this study randomized pairings to measure specific relationships, in practice, an instructor might consider giving students a choice among discussion topics for a given assignment. This way, students can self-organize based on interest and experience, which will set the stage for co-constructive dialogue. Sometimes, it may be necessary to restrict the students' choices of topics. For example, if the instructor considers a topic essential to the course, it is reasonable to ask all students to explore that topic. Additionally, an instructor may wish to design an activity to create a common experience from which students will subsequently be asked to make meaning. Like all design decisions, these instances should be intentional rather than arbitrary.

Discussion of Research Question 2

This section presents the findings separately for Research Questions 2a and 2b. Each question is addressed first by relating the findings to recent literature and followed by implications for further research and applied practice.

Findings of Research Question 2a Related to the Literature

This section discusses the patterns of knowledge co-construction as revealed in Research Question 2a. to address this question, the discussion considers how the design of learning activities shapes patterns of co-construction through role assignment and phasing of discussions.

Patterns of Co-Construction Related to Design of Learning Activities. Research Question 2 used social network analysis and the interaction analysis model (Gunawardena et al., 1997) to examine the patterns of social knowledge co-construction in large group discussions. This section relates the study's findings concerning role assignment and phase structure to relevant literature on knowledge co-construction in online learning environments. It then looks at the characteristics of the individual within the discussion, contrasting participation with contribution to knowledge co-construction. As noted by Gomez and del Rosario (2018), the "conceptual overlap between the interaction analysis model and social network analysis" creates a simultaneous means of studying the product and the process of social knowledge co-construction (p. 287). Gunawardena et al. (2016) refer to social network analysis as a tool to "x-ray" the process of social knowledge co-construction (p. 54).

Role Assignment. DeWever et al. (2008) demonstrated that when assigned to perform scripted tasks in an online discussion, students behave in accordance with assigned roles. In their follow-up study the researchers demonstrated that structured role assignment led to discourse

with higher IAM levels (DeWever et al., 2010). The present study extended this line of inquiry by looking at the individual contributions of students performing specialized roles and found evidence suggesting that students appear to fulfill their roles to varying degrees. Further, social network analysis indicated that when students performing the catalyst role contribute successfully over the duration of assignment, a greater number of discussants contribute as well. In addition to role assignment, Wenting (2017) emphasized the importance of creating interdependence of roles to further promote student engagement by creating a sense of mutual responsibility. Using this insight from Wenting, the current study emphasized role interdependency. However, while Wenting's study demonstrated the value of creating interdependency, the current study simply demonstrated how when students fulfilled their interdependent roles as assigned, greater numbers of fellow students contributed to knowledge co-construction. Recall from Chapter Four that the phase 1 catalyst of the first major case study was a central figure in a dense co-construction network while the student performing the same role in the second case study had lower network centrality in a co-construction network that was considerably less dense.

Structured Discussion Phases. Aviv et al. (2003) demonstrated a phased approach to case study discussions, where the structure and focus of each phase was designed to progress knowledge co-construction from lower IAM levels in the first phase to the highest IAM level in the final phase. His study contrasted two versions of the same course, one with phased discussions and one with open discussions and found that the structured approach, was far more successful in achieving high levels of knowledge co-construction. Gomez and del Rosario (2018) did not have a strict phase structure like Aviv et al. (2003), but over the course duration, they divided the class discussion into a sequence of three forums which shifted from concrete

and objective aims to more abstract and contextual ones as the course progressed. They found that IAM Level 4 and Level 5 statements were found only in the final discussion forum (Gomez & del Rosario, 2018). Consistent with both studies, findings of the current study revealed that the later discussion phases produced higher level IAM statements.

Research Question 2a: Implications for Research

While social network visualizations from the current study suggest that the catalyst role, when performed by students who can spur discussion with engaging and insightful questions, can promote greater class participation in knowledge construction, this phenomenon should be studied more closely. One way to do this would be to create a performance rubric for specialized roles and quantitatively compare rubric scores to network centrality and density measures for each member performing each specialized role. A caveat to this approach is that to reduce the potential for the rubric to bias the result it would be prudent to de-couple the rubric from the grading process. Future research incorporating both role assignment and structured phases could look at the relative contribution of different roles for each phase. Understanding variation in the prominence of different roles over the lifecycle of phases could be used iteratively to improve the assignment of tasks for each role within each phase of discussion.

Research Question 2a: Implications for Practice

Both Buraphadeja (2010) and Heo et al. (2010) noted that students appear to reach IAM level 5 agreement without going through the process of testing new ideas against received fact or theory. This amounts to agreeing upon untested ideas, which arguably implies reduced critical thinking at the stage leading up to knowledge application and therefore, a reduction in the quality of co-constructed knowledge. Buraphadeja (2010) cites two possibilities for why this may happen. First, in his study, the instructors did not engage in Socratic questioning of students, a

technique employed by Yang et al. (2005) as well as Hull and Saxon (2009). Similar to the present study, Buraphadeja (2010) sought to avoid the instructor biasing the results. A hands-off approach, while an effective means of reducing bias, still represents a departure from best practices in distance education, which call on instructors to keep students motivated and to participate in discussions (Ringler et al., 2017) and actively encourage critical reflection and knowledge co-construction (Palloff & Pratt, 2001). Student learning in the course associated with the present study could arguably have been increased if the instructor or teaching assistant took specific mitigation steps when the discussion got off track. First, when student-authored major case study prompts asked students to offer solutions at a time when they were supposed to be focused on problem identification, a review prior to release could have prevented the class getting off track. Second, in phases where the catalyst did maintain active participation through the entire week, intervention could have resulted in greater participation or a possible switching of roles if the catalyst found herself unable to fulfill assigned duties. As Simonsen et al. (2015) note, sustaining meaningful online interaction is difficult but the instructor must sharpen the tools of collaboration. However, the instructor's engagement needs to be balanced against two aspects of social distance (Freeman et al., 2003). On one hand, a lack of feedback from the instructor can add to student isolation by ignoring the basic need for validation (Freeman et al, 2003). However, if feedback is too critical, this can increase social distance by adding fear, potentially leading to disengagement (Draves, 2003). Considering the structure of the major case studies in the current study, where students were assigned specialized roles in a rotational basis, it may be wise to direct instructor feedback towards those students assigned leadership roles and empower these students to provide feedback to the class. Because roles are rotated, no single student would be subjected to ongoing critique. Additionally, empowering the role-players to

provide general feedback, once receiving guidance from the instructor, will allow them do practice some of the leadership skills they are studying.

Findings of Research Question 2b Related to the Literature

Research Question 2b examined the relationship between participation and knowledge co-construction. When studying this relationship Buraphadeja (2010) observed no correlation between a student's level of demonstrated knowledge co-construction and his or her centrality in the participation network. Similarly, Gomez and del Rosario (2018) reported mixed results finding many cases where both out degree and in-degree centrality was linked to higher IAM-level utterances but also several cases where low-centrality students produced for high-level IAM statements. As discussed in Chapter Two, a common challenge to both of those studies was the lack of a direct measure of a student's contribution to knowledge co-construction. In the absence of direct measure, researchers record a student's highest IAM-level utterance as a proxy for contribution. The present study defined and demonstrated a ruleset to attribute student contribution across all IAM levels. This reduces bias favoring students who enter a discussion in its later phase where higher IAM level discourse is expected. It instead recognizes the fact that constructions reaching the highest phases must be built upon the contributions of those who laid the foundation at lower levels.

With the ruleset in place to address the issues of indirect measurement and bias, the present study sought to re-examine the relationship between participation and co-construction. Specifically, the researcher examined the correlation between three types of network centrality: out-degree (a measure of student posts submitted), in-degree (a measure of posts received by a student), and betweenness (a measure of the extent to which information flows through a student) As discussed in Chapter Four, across the study's two major case studies, only the

relationship between out-degree centrality and co-construction was significant in both, suggesting a moderate correlation.

Research Question 2b: Implications for Research

Future research seeking to relate the characteristics of students to their levels of knowledge co-construction should consider using or improving the ruleset presented in this study. If adopted for use in conjunction with the interaction analysis model and social network analysis, the ruleset may enable more repeatable studies in which knowledge co-construction can be examined at the individual level. Although simply stated, applying the ruleset can be complicated when measuring behaviors closely tied to roles and phases. For example, consider a student performing a summarizer role selects excerpts from classmates posts and attempts a synthesis, which itself represents a co-construction. In this study, students whose contributions made it into the synthesis were credited with additional contributions, while those whose inputs were not included were overlooked. This is consistent with the study's deference to constructionism over constructivism, where the emphasis in on the artifact of co-construction. However, studies relying on a more constructivist framework will need a more equitable way to credit individuals whose ideas may have demonstrated higher order thinking but managed to escape the notice of the student summarizer.

Research Question 2a: Implications for Practice

It may seem intuitive that high levels of participation are related to higher levels of knowledge co-construction. However, as the studies discussed previously found, this is not always so. Participation frequency does not speak to quality of what is written. In the current study, expectations associated with roles and phases were clearly stated and the purposes behind these expectations were centered on promoting knowledge co-construction. In the current study,

the alignment between learning activities and knowledge co-construction was evident in the levels of co-construction observed. As a result, participation was predictive of knowledge co-construction. The more deliberately online instructors develop and align their learning activities to their intended outcomes the more dependently they can rely on the relationship between participation and co-construction. Admittedly, using the IAM to verify that knowledge co-construction is taking place requires a significant investment of instructor time. However, once the instructor verifies that the learning activities consistently produce knowledge co-construction, he or she can take advantage of the relationship between participation and co-construction and use social network analysis an efficient proxy for monitoring co-construction.

Conclusion

This study explored relationships between individual roles and relationships of power, existing between adult students, influences their ability to co-create knowledge and shape the patterns through which knowledge is constructed in an online learning environment. The study used a survey instrument of student experience to measure power parity between pairs of students and the interaction analysis model (IAM) to score the quality of co-constructed knowledge. Then, the researcher defined a ruleset for attributing individual contributions to knowledge co-construction and used this tool in conjunction with the IAM and social network analysis to explore the patterns of co-construction in large group discussions, which were conducted in phases and featured students assigned to perform specific roles. The study contributes to the current literature in several ways. First, theoreticians and researchers in the constructivist tradition have suggested that knowledge co-construction is more likely when participants are equally matched. This study is the first known attempt to explore this assertion empirically. Next, while many researchers have taken advantage of the synergy that exists between the IAM and social network analysis, studies seeking to understand the individual's role in the shared

process of knowledge co-construction have lacked an instrument to capture individual contributions. The ruleset presented here was a first attempt at creating a practical and equitable way to identify individual contributions to a multiparty knowledge construction. It is my hope that the work presented here will enhance future research in social knowledge co-construction. As a lifelong learner and an experienced distance learning instructor, I believe the findings will shape online teaching practice by providing both tools of instruction and tools of evaluation.

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Appendix A

IRB Approved Recruitment and Consent Materials

IRB-Approved Recruitment and Consent Materials

RECRUITMENT SCRIPT

(verbal, in person)

My name is James Slear, a graduate student from the Department of Educational Leadership, Foundations, and Technology at Auburn University. I would like to invite you to participate in my research study to examine the process of social knowledge co-construction and negotiated meaning in an online leadership course. Each if you enrolled in this class (EDLD 8210) is eligible to participate.

As a participant, you will be asked to complete an online survey, which should take no longer than fifteen minutes to complete. The survey will ask you to rate your knowledge and experience on a list of topics that surface frequently in school leadership contexts. I will then analyze the assigned discussion board transcripts for our course using a model that quantifies the degree to which each threaded discussion produced new socially-co-constructed knowledge. I will study the relationships between relative experience levels among discussants and the level of co-constructed they produce.

(*Briefly discuss any risks, compensation or benefits, costs, privacy issues, or other information that would likely influence the participant's interest in the study*)

- **Risks**: (1) Breach of confidentiality - Participating in electronic surveys invites the possibility that the information you provide may be compromised. (2) Coercion – Because I am recruiting with your instructor's permission, you may feel coerced into participating. Your instructor will not be made aware of your participation status until after final grades are posted. Because I am serving as a TA for the course, you may be concerned that I may punish non-participation through grading. Although I am moderating online discussions, I am not assigning you grades of any kind. (3) Social – Because I am recruiting in class, you may feel uncomfortable declining publicly. You may decline privately by turning in your consent form unsigned, or you may simply revoke your consent later in private.
- **Compensation/Benefits**: There will no compensation for or direct benefits of your participation.
- **Cost**: There are no costs to your participation.
- **Privacy issues**: All data collected will remain confidential as will your participation status. Once I obtain your data, I will convert your name to an arbitrary two-letter identifier to prevent your association with the data. The use of Qualtrics for the electronic survey presents no greater risk than the everyday use of the Internet. I will not collect IP addresses or any additional identifying information from the server. The findings of this research study will be used to fulfill an educational requirement for a dissertation and may also be used to create presentations or publications.

If you would like to participate in this research study, please sign and both of the consent forms I have provided. Please remember to initial the first page of each form and sign the bottom. I will make a copy of your signed consent forms and return them to you for your records.

Do you have any questions now? If you have questions later, please contact me at jns0048@auburn.edu or you may contact my advisor, Dr. Reames at reamseh@auburn.edu.

Allow Space for the AU IRB Stamp

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DEPARTMENT OF EDUCATIONAL FOUNDATIONS,
LEADERSHIP AND TECHNOLOGY

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS
IRB APPROVAL INFORMATION WITH CURRENT DATES
HAS BEEN ADDED TO THIS DOCUMENT.)

(ELECTRONIC SURVEY) PARTICIPANT INFORMED CONSENT
for a Research Study entitled

"Patterns of knowledge co-construction in an online educational leadership course"

You are invited to participate in a research study. I am asking you to participate in a research study titled "Patterns of knowledge co-construction in an online educational leadership course." I will describe this study to you and answer any questions that you may have. The study is being conducted by James N. Slear. The faculty advisor for this study is Ellen Reames, Professor in the Auburn University Department of Educational Foundation, Leadership, and Technology.

What this study is about: The purpose of this research is to examine the relationships and patterns of interaction associated with the social co-construction of knowledge in an online educational leadership course. The researcher's intent is to further understand how to improve the quality of peer-to-peer interaction in online learning.You were selected as a possible participant in this research study because of your present enrollment in EDLD 8210 and because you age 19 or over.

What I will ask you to do: If you agree to participate in my research, I am asking for you to complete an electronic survey titled "Student self-report of educational leadership experience" which will be sent to you via Qualtrics to your Auburn email address. The survey will ask you to rate your level of experience with 25 topics common to educational leadership, It will also you how many years of experience you have in different administrative and leadership capacities.

Risks and discomforts: Breach of confidentiality is the risk associated with participating in this research study due to the use identifiable data. To minimize this risk, I will replace your names with arbitrary two-letter identifiers once I download the results. The use of the electronic data sent via email presents no greater risk than everyday use of the Internet. There is also the risk you may feel coerced or socially pressured into participating. To minimize this risk, I will not share the status of your participation with the course instructor until after final grades are assigned. Further, since I am collecting consent forms, you may turn in a blank form or your may simply ask me to withdraw privately at any time.

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AUBURN, AL 36849-5221

TELEPHONE:
334-844-4460

FAX:
334-844-3072

www.auburn.edu

Benefits. If you participate in this study, you can expect no direct benefits. However, an indirect benefit is that information from this study may be used to benefit future online courses. I cannot promise that you will receive the receive the benefit describe.

Compensation for your participation: There will be no compensation offered.

Costs involved: There are no costs related to your participation in this study.

Privacy/Confidentiality/ Data Security: Your privacy will be protected. Any data obtained in connection with this study will remain confidential. The researcher will not use any personally identifying information in the analysis or presentation. The findings of this research will be used to fulfill an educational requirement for a dissertation; and may also be used to create presentations or publications.

Taking part is voluntary and you may withdraw at any time during the study. You may refuse to participate before the study begins. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University, Department of Educational Foundation, Leadership, and Technology or those people involved in this study.

If you have questions: Please ask any questions you have now. If you have questions later, you may contact Dr. Ellen Reames at reamseh@auburn.edu or James Slear at jns0048@auburn.edu. If you have questions regarding your rights as a subject in this study, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

_____	_____
Participant's signature/Date	Investigator obtaining consent/ Date
_____	_____
Printed Name	Printed Name

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DEPARTMENT OF EDUCATIONAL FOUNDATIONS,
LEADERSHIP AND TECHNOLOGY

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS
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HAS BEEN ADDED TO THIS DOCUMENT.)

(DISCUSSION THREAD) PARTICIPANT INFORMED CONSENT
for a Research Study entitled

"Patterns of knowledge co-construction in an online educational leadership course"

You are invited to participate in a research study. I am asking you to participate in a research study titled "Patterns of knowledge co-construction in an online educational leadership course." I will describe this study to you and answer any questions that you may have. The study is being conducted by James N. Slear. The faculty advisor for this study is Ellen Reames, Professor in the Auburn University Department of Educational Foundation, Leadership, and Technology.

What this study is about: The purpose of this research is to examine the relationships and patterns of interaction associated with the social co-construction of knowledge in an online educational leadership course. The researcher's intent is to further understand how to improve the quality of peer-to-peer interaction in online learning.You were selected as a possible participant in this research study because of your present enrollment in EDLD 8210 and because you age 19 or over.

What I will ask you to do: If you agree to participate in my research, I am asking for your permission to analyze text from your Canvas discussion board threads assigned during the course EDLD 8210. If I have your permission, I will download your threaded data. To protect your confidentiality, I will replace your name with an arbitrary two-letter identifier prior to conducting my analysis. The text will provide valuable information about how you communicate with peers to co-construct new meaning.

Risks and discomforts: Breach of confidentiality is the risk associated with participating in this research study due to the use identifiable data. To minimize this risk, I will replace your names with arbitrary two-letter identifiers once I download the results. The use of the electronic data sent via email presents no greater risk than everyday use of the Internet. There is also the risk you may feel coerced or socially pressured into participating. To minimize this risk, I will not share the status of your participation with the course instructor until after final grades are assigned. Further, since I am collecting consent forms, you may turn in a blank form or your may simply ask me to withdraw privately at any time.

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Benefits. If you participate in this study, you can expect no direct benefits. However, an indirect benefit is that information from this study may be used to benefit future online courses. I cannot promise that you will receive the receive the benefit describe.

Compensation for your participation: There will be no compensation offered.

Costs involved: There are no costs related to your participation in this study.

Privacy/Confidentiality/ Data Security: Your privacy will be protected. Any data obtained in connection with this study will remain confidential. The researcher will not use any personally identifying information in the analysis or presentation. The findings of this research will be used to fulfill an educational requirement for a dissertation; and may also be used to create presentations or publications.

Taking part is voluntary and you may withdraw at any time during the study. You may refuse to participate before the study begins. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University, Department of Educational Foundation, Leadership, and Technology or those people involved in this study.

If you have questions: Please ask any questions you have now. If you have questions later, you may contact Dr. Ellen Reames at reamseh@auburn.edu or James Slear at jns0048@auburn.edu. If you have questions regarding your rights as a subject in this study, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

_____	_____
Participant's signature/Date	Investigator obtaining consent/ Date
_____	_____
Printed Name	Printed Name

Appendix B

Definition of Key Terms

Definition of Key Terms

While I have tried to avoid the use of jargon throughout this paper, there are words and phrases used throughout whose use could be misunderstood without clarification. This limited list of terms is explained here.

Negotiated Meaning

When an individual receives new information, he or she must interpret its meaning. In her social cognitive theory of writing, Flowers (1994) describes the process of negotiating meaning primarily in terms of how a reader makes sense of what is read. When dealing with static text, it follows that negotiation is a one-party endeavor where the reader negotiates with his or her current understanding or schema (Piaget, 1967). However, in an interactive written discussion, negotiation of meaning is more dynamic as each party is actively responding to the inputs of the other. In his research on online discussion forums, Stahl (2003) provides a description that most closely resembles how negotiated meaning is used in the present study: "Knowledge negotiation focuses on evolving a group knowledge artifact to a mutually acceptable status for publication, rather than reaching consensus on a pre-existing choice of personal opinions" (p. 2).

Co-Construction

This term is used throughout this paper is based on Papert's constructionism. A construction is an artifact or product. In the context of an online discussion forum, the construction is the transcript of interaction. As a dialogue, it may contain evidence of change, such as discussions of ideas, signs of compromise, and other indicators used in the interaction analysis model (Gunawardena et al., 1997). However, this evidence is not likely to represent all the cognitive changes among the participants. This is a key delimiter between the cognitive and social constructivism of Piaget (1967) and Vygotsky (1978) and the constructionism of Papert (1991). This study confines its inquiry to what is written and can be readily interpreted by the reader. Therefore, wherever the paper refers to knowledge co-construction, it refers to the written artifact of that construction.

Centrality

In social network theory, centrality is can be thought generally as "the contribution a node [actor] makes to the structure of the network" (Borgatti, 2018). This definition can easily be transferred to the learning environment where the nodes are students and the network is set of relations occurring between them. A central student then, is one whose actions have a marked impact on the learning environment. There are many different ways a student can influence the learning environment and therefore there are many different measures of centrality. The present study considers three such centralities. Normalized out-degree centrality or influence is a measure of a student's direct contribution to class discussions relative to the contributions of others. Normalized in-degree centrality or prestige is a measure of the tendency of others to engage one student, relative to others, in their participation. Freeman betweenness centrality measures how many times a student lies along the shortest path of communication between all

other pairs of students (Wasserman & Faust, 1994). When this value is normalized it represents the student's betweenness relative to others. In information environments, such as learning networks, actors with high betweenness are considered information brokers or individuals through whom ideas from different actors are exchanged.

Appendix C

Weekly Case Study Prompts

Weekly Case Study Prompts

The appendix contains the instructor-created prompts for the ten weekly paired case study discussions, which were associated with research question 1.

Case 1.1 discussion prompt: This case study, *Balancing the Workload*, centers on a faculty's collaborative approach to placing special needs students equitably among teachers. Create an original post of approximately 300-500 words that describes the central problem or problems in the case and offers positive steps toward resolution. In your post, consider one or more of the following course concepts in discussing both the problem and the steps toward resolution: (1) Power, in terms of types and usages and the changing nature (generational/technological) of how power is regarded; (2) Assigned vs emergent leadership; (3) Leadership vs management; (4) Coercion.

Case 3.1 discussion prompt: In this case study, *Before Barb Burns Out*, Barb has tremendous responsibility including budgeting, grant management, community partnerships, staffing, and overseeing programs at 11 different schools. Create an original post of approximately 400-600 words that frames and describes the central problem in this scenario. Identify which missing or under-developed skills, from either or both of the chapter's two models are most consequential to Barb's struggles. Recognizing that skills cannot be developed overnight, what steps might Barb take to improve her situation and the status of her programs?

Case 5.1 discussion prompt: *A Tale of Two Teams*. The Situational Leadership II model positions the leader such that he or she knows what needs to be done and getting it done is a matter of giving the right instructions and support based solely on the follower's task-related know-how and level of commitment. How well does that premise stand with respect to Principal Hernandez? He knows scores are low and that his boss is unhappy. What does he know about his followers, Ms. Jones and Mr. Milton? Did the principal even have the knowledge necessary to apply the model? What about the superintendent? From his view, we know that accountability pressures are promoting him to lean on Principal Hernandez to "raise scores" and not much else. If you were given a chance to repeat this scenario from the beginning, how would you advise both the principal and the superintendent to apply the model to the scenario. Create an original post of approximately 300-400 words. Use references from the text to support your answer.

Case 7.1 discussion prompt: *Favoritism in the Classroom.* One of the strengths of LMX is that it can be used both to describe leadership relationships and to prescribe actions to mature and evolve these relationships for mutual benefit. At the same time, one of the critiques of LMX is that the prescription, improve the quality of interactions, is rather vague. Nonetheless, we will try to apply this model to the case at hand. In this scenario, it is clear that the classroom has an in-group and an out-group, which arises, at least in part, from the behavior of the teacher, Mr. Mitchell. Let's consider Mr. Mitchell's behavior, not as the leader of the classroom, but as a follower of Mr. Aidan Dennis, the charter school. At what level of leader-follower relationship do you suppose Mr. Mitchell and Mr. Dennis are? Based on what he observes in the classrooms, what steps should Mr. Dennis take to engage Mr. Dennis and evolve their relationship into the

mature phase, where Mr. Mitchell performs better, demonstrates greater commitment to his mission (which includes educating students who may have ADD or other learning disorders) and acts in the best interest of the entire learning organization? Create an original post of approximately 400-600 words. Use references from the text to support your answer.

Case 8.1 discussion prompt: *Creating a Magnet School*. Transformational leadership consists of four distinct behaviors: idealized influence, inspirational motivation, intellectual stimulation, and individual consideration. One of the strengths of the transformational model is that it acknowledges that leadership behaviors are not applied uniformly to situations but contextually to unique individuals. Case 8.1, Creating a Magnet School, takes place in an urban school undergoing federally-mandated desegregation. The principal, Joan, displayed all four of these behaviors in leading her school's transformation to become a writing-focused magnet school. Which one of these transformational behaviors do you think was MOST responsible for her success and why? In an original post of approximately 300-400 words, describe the actions Joan took that exemplified this particular transformational behavior and based on the definitions in the chapter reading, clarify HOW the particular actions you describe align with the behavior you identified and explain why you think they were effective.

Case 14.1 discussion prompt: *School Improvement Team Troubles*. There are eight measures of team effectiveness (pp. 376-379), each of which are needed for successful team outcomes. Considering Case 14.1, the literacy committee is deficient in more than one of these measures. Perhaps literacy is more complicated because it involves specialized knowledge. Perhaps it is more difficult to organize teams in large urban settings. Perhaps this principal chose the wrong areas to prioritize the efforts of the school improvement team. In any event, write an original post of approximately 400-500 words, identifying which ONE of the 8 measures of team effectiveness you consider to be the ROOT deficiency or the one that you would advise Gloria to address first. Justify your answer by explaining how addressing this particular deficiency will clear the path toward making other changes to turn the team around. There are no wrong choices to this question, but your explanation should make a compelling case for why you chose this area above all others.

Case 9.1 discussion prompt. *Parents, Principals, & Playgrounds: Oh My! t*akes place within a rural school setting with an active PTO. The case contains a safety related matter that occurs along the seams between the school administration and the PTO. While the administration maintains overall safety responsibility, it is the PTO who will have to fund any material improvements to the playground. The principal, Alex James, is only in his second year but appears to have done a good job building relationships. Recall from the chapter reading, there are three approaches to studying the authentic leadership model. One of these, the theoretical approach, consists of four components defined on pp 203-205: Self-awareness, Internalized moral perspective, balanced perspective, and relational transparency. In an original post of approximately 400 words, identify which of the four components Principal James exhibits most strongly and which one you believe he might develop or demonstrate more of. Use evidence from the case to support your reasoning including the context in which the story takes place and the nature of the conflict.

Case 10.1 discussion prompt. *Stewardship Abounds*. This case takes place in a unique cultural context, namely a quasi-rural school whose faculty had not seen a single personnel change in 25 years. The principal, Lee Brown, wants to ensure the two first-year teachers are mentored and that they have everything they need. Perhaps this mentoring will ensure the new teachers learn the school's mores and norms, which are likely deeply ingrained in this school with its exceptionally low turnover rate. The servant leadership model says that leaders must consider both the culture and context in which they serve and the followers' receptivity when selecting appropriate behaviors. In selecting appropriate behaviors in this case, there appears to be a conflict between "helping followers grow and succeed" and "empowering." In light of these considerations, create an original post of approximately 300-500 words detailing how you believe Principal Brown proceed from here and why.

Case 11.1 discussion prompt. *Pride, Policies, and Promise*. In this case, which takes place in a rural context, a teacher wants to personally fund a particular educational opportunity for one of his students. The student's parents object to her accepting the funding and current schoolboard policy prohibits such a financial exchange. Areas of conflict exist between: (1) the student's desire and those of her parents; (2) teachers who support the benefactor's intention to pay the student's expenses and the school board policy which seeks to maintain boundaries and avoid the perception of favoritism by prohibiting teachers from providing [financial] favors to students. (3) students who believe their classmate deserves this opportunity and those who believe Maria should obey her parents' wishes; (4) school board members who believe the current policy is appropriate and should be enforced and those who believe an exception should be made declaring the teacher's financial gift "a scholarship" so that it may be offered.

The adaptive leadership model says that adaptive work often requires a change in values. But as Northouse notes, the model is criticized because it does not explain how the "evolution of values leads to a greater common good" (2019, p. 275). As you address the prompt below, consider the role of values in this case. In an original post of approximately 500-700 words, answer the following questions. First, given the set of divides that exist across the many stakeholders, what would you consider to be the desired goal or end for this case? Is this a case for adaptive leadership?

If so: What would you consider the situational challenges of the case and to what category do they belong (technical, technical and adaptive, adaptive)? Of the model's six leadership behaviors which one(s) should the principal practice to achieve this goal? Describe the holding environment(s) needed to do the adaptive work. If you believe this is NOT a case where adaptive leadership is appropriate, why not? How would you resolve the matter and what leadership behaviors (from any of the models we have studied) would you employ?

Case 12.1 discussion prompt. *Revamping the Robotics Team.* Like all case studies, context matters. In this case consider first, robotics teams in general. What are the basic objectives of a robotic teams such as how the team organizes addresses complex problems are solved? This school also takes place in an urban setting where parent work schedules may limit student availability to participate in extra-curricular activities.

One of the theoretical lenses for looking at followership is the co-construction of leadership (pp 304-306). Here, leadership is the state or set of conditions resulting from the ongoing interaction of leaders and followers in terms of their behaviors. For our purposes, consider the faculty advisor/coach, Mr. Dumont, to be the leader and the students to be the followers. In an original post of approximately, 400 words, describe the evolution of leadership as the case unfolded, in terms of the interaction of behaviors between the leader and the followers. Considering how robotics teams are required to perform, how might we conjecture how the team benefited from this evolution in terms of leadership skills development?

Appendix D

Student Instructions for Major Case Studies

Major Instructions for Major Case Studies

Student Roles for Case Studies Differentiated by Phase

Overview

Each week students are assigned one of five specific roles to fulfill in their ***Weekly Contribution to Major Case Studies.*** These roles are described below. Required tasks for each role vary according the to the analysis phase. These details are contained in the subsequent section, ***Analysis Phases***.

Roles

The five different discussion roles assigned on a weekly-rational basis are: *facilitator, catalyst, search engine, summarizer*, and *participant*.

Facilitator. The facilitator is responsible for framing and organizing the discussion in accordance with the objectives of the current *analysis phase*, keeping the students on topic and progressing towards deadlines. The facilitator can comment on any post as he or she wishes, but the primary task is to get others talking. Therefore, when posting to one student, it is helpful to reference other student's input.

Catalyst. This student plays a devil's advocate role, identifying sources of disagreement and highlighting contradictions and unwarranted claims.

Search Engine. This student is responsible for locating additional resources to further solution development. These sources could include, for example, journal articles discussing relevant application of specific leadership models or theories or credible data sources containing facts and figures applicable to the problem domain. Your online account with the AU library is the key to all resources you may need. Through that account, you have access to thousands of periodicals. Also, when you access Google Scholar while logged into you library account, you will find that many more of the sources you find are available in full text than when you access Google Scholar directly.

Summarizer. This student synthesizes the week's discussion into a coherent expression of the state of problem resolution at week's end.

Participants. Students not assigned to specialized roles are asked to contribute to the discussion, according to the posted instructions of the current phase.

Analysis Phases

This section defines the discussion activities required for each of the four discussion phases. Role-specific tasks are also defined within each phase.

Phase 1: Framing the problem. These cases contain a good deal of detail and usually, there are multiple problem indicators. In this first phase, we consider these details and try to formulate a clear problem statement. This statement can be considered the root problem, or at least the root of the problem that is within the span of influence of the participants. Once identified, we can describe the problem as a *state*, having specific *conditions*. Once our *problem* state is defined, we can describe a desired *future* state in which the problematic conditions have been successfully addressed. In the remaining phases, we try to close the gap between the problem state and the desired future state.

Facilitator. To get the ball rolling, the facilitator poses the first set of questions. Solicit inputs to help get people talking about the problem. At the end of the case study narrative, there are two questions under the heading **Problem Framing**. This is a good place to find ideas. Craft a question or two as you see fit. Allow people to respond freely, but when you see people straying from the task of identifying problems and venturing into proposing ideas, gently nudge them back on task. Towards the end of discussion period, start identifying sources of agreement.

Catalyst. Problem identification is important. If the class comes together too easily on the nature of the problem, they may not be giving the matter enough thought. These cases are complex, and actions always have consequences. Your task is to look at your peers' inputs and offer some what-ifs situations to make sure they consider the case study problem from the perspective of all case study characters, not just the principal.

Search Engine. If there is any debate about pertinent facts in the case, your task is to provide clarification. Sometimes, the case study omits some detail to represent the ambiguity of the real world where no one is in possession of the whole truth. When two or more of your peers appear to have read or interpreted a basic fact of the case differently, it is your job to resolve this conflict, quickly, so that everyone is actually trying to solve the same problem. You are the fact checker and need to adjudicate disagreement about basic facts.

Summarizer. Your role comes in near the end of the discussion period. Once your classmates have begun to converge on the nature of the problem, your task is to draft the authoritative problem statement and desired end state. When there is prolonged disagreement, you must find a tactful way to reconcile differences, helping the parties negotiate if needed.

Participant. Your role is to join the discussion, by addressing the question(s) posed by the facilitator. Your inputs should help define the exact nature of the problem, which includes descriptions of the *current* and *desired end states*. If you are the first to respond to the facilitator's initial prompt, check back throughout the week as others may have followed up with additional questions. If you are not the first to post, then enter your post as a response to the previous post, considering that author's point of view while expressing your own. Statements such as "I totally agree…", without at least some additional consideration or evidence, are not very helpful in moving the analysis forward.

Phase 2: Developing solutions. In this phase, we offer suggestions to address one or more of the problematic conditions of the case. Through our discussions, we advocate for or against potential solutions, considering possible consequences of our decisions. Here, our personal experiences, leadership styles, and even personality types may come into conflict. That's ok. These differences become like colors on an artist's palate, the greater variety, the greater the potential to create a masterpiece of a solution.

Facilitator. You begin this phase, with the class problem statement and desired end state. Your task is to get the class working on developing solutions. During the first week of the phase, direct you efforts towards soliciting as many ideas from everyone. At the end of the case study narrative, there are questions under the heading **Questions and Suggested Activities**. As you write your discussion prompt, consider using or rewording one or more of these questions to get the conversation started. At the end of the first week, switch your focus towards promoting debate concerning the strengths and shortcomings of the various solution proposals. Guide the participants towards converging on one solution and refining it. Wait for the summarizer to post a summary of the ideas put forth before you switch. Reach out to the summarizer directly if he or she has not posted the summary at the end of the first week.

Catalyst. In this phase, your role as devil's advocate comes to light. During the first week of discussion, your task is to read the various problem solutions put forth and uncover any weaknesses they possess. Weaknesses may be found in solutions whose actions: (1) address one aspect of the problem while potentially creating new ones; (2) appear incomplete, that is they address only one aspect of the problem; or (3) do not contain sufficient evidence or logic to justify the approach. Make note of all of these shortcomings, but DO NOT POST THEM until the facilitator signals that it is time to start debating the ideas put forth. If you deliver your critique too soon, you may discourage others from submitting ideas. Therefore, you should deliver your critiques after all ideas have been put on the table.

Search Engine. In this phase, participants will be putting forth ideas and then critiquing them. Your job is to collect outside facts and references which may be helpful. For example, if a participant makes generalizations about the effects of disciplinary practices on graduation rates, you could find a current data source that puts facts and figures to this assertion. At the end of the case study narrative, there is a section called **Suggested Readings**. This may be a good place to start. Most of those sources are available to you through your online account with the AU Library. Google Scholar and state and federal Department of Education websites are also good places to look. Alert the participant to these sources on the discussion board and post any full text documents to the Discussion Library, which is accessed on Canvass under the **Pages** tab.

Summarizer. This phase spans two weeks. In the first week, participants put forth possible solutions to the case study. In the second week, they debate, evaluate, refine and select a class solution. At the end of the first week, make a brief statement summarizing the ideas put forth. If some of the solutions are similar, you can combine them, noting differences that still need reconciliation. The facilitator requires this summary before he or she can move the class into the debate and refinement portion of this phase. At the end of the second week, write a

statement describing the class's negotiated solution. Be sure to include sufficient detail as your statement will be used as the primary reference in the next discussion phase.

Participant. In the first week of the phase, the facilitator will assign a discussion prompt asking you to offer possible solutions to the case study. It is important that you tell the class not only *what* actions should be taken, but *why* you believe they will be effective. Further, you should consider any possible unintended consequences of your proposed action and describe how your solution would mitigate these should they arise. In the second week of the phase, you join the debate and refinement of a class solution. You may find yourself defending your idea, abandoning your idea in favor of another, or reconciling your idea with another one to offer a better solution. During this process, keep an eye out for inputs from the *catalyst*, whose job it is to challenge your idea. In addition, the *search engine* may provide additional resources that support or refute one or more of your claims, so check the discussion thread a day or two after posting.

Phase 3: Testing solutions. Remembering this is a course in leadership *theory*, we take time in this phase to look at our candidate solution(s) through the lenses of different leadership models and theories. Our textbook, the current literature, and insights from our personal experience provides us with evaluative criteria we can apply to our solution and our underlying assumptions. When our solution is found to be at odds with newly gathered facts, or in conflict with various leadership principles, we refine our solution to account for these factors.

Facilitator. By this point in the course, you have studied several leadership models and theories. *For the first week of this phase*, write a discussion prompt that asks your class to examine the case (with emphasis on the class solution), through the lens of one or more theories from the course. In other words, does your problem statement and solution favor the language of the skills model, emphasizing specific skills that need to be applied to the problem, or is more suitably examined using a situational model. Your question should prompt discussion in this area. Your prompt may ask participants to focus on one model at a time or you may choose a more open-ended approach. Either way, your job is to keep the discussion focused. *For the second week*, use any insights gained from the first to guide the class towards improvement of their solution. Solicit minor improvements and see to it that the solution addressed issues or challenges raised by the *catalyst* or information shared by the *search engine*.

Catalyst. In your devil's advocate role, you are asked to challenge participants in their assertions. For example, if someone expresses certainty that the entire case study can be described within the context of the *Situational Leadership Model*, your task would be to consider how well-supported the assertion is and to offer critique. Your efforts should wind down by the end of the first week of this phase. For the second week, you can either serve as a *participant* or take the week off.

Search Engine. In this phase, the discussion examines the case study in the context of one or more leadership theories. Once these theories are identified, you can locate additional sources that discuss or critique these models. As you find relevant sources, notify the class

through the discussion board and post any full-text references to the Discussion Library, which is accessed on Canvass under the **Pages** tab.

Summarizer. At the end of the second week of this phase, write a statement that includes the final solution and highlights any refinement resulting from the discussions over the past two weeks.

Participant Address the question put forth by the facilitator at the beginning of the phase. Check back periodically to address any comments or inputs directed to you by any of your classmates.

Phase 4: Reflecting and Applying. In this final phase, we reflect on the case, relating it to our personal experience. We consider how our perspectives may have been altered though the analysis process and how we may apply any lessons learned to our future leadership challenges.

Facilitator. For this final week, craft a discussion prompt asking your classmates to share what they learned through this experience and how they might apply what was learned in their professional practice.

Catalyst. No assigned role.

Search Engine. No assigned role.

Summarizer. At the end of the week, write a statement synthesizing the lessons learned from your classmates. You do not need to include every detail, but your post should encapsulate the voice of your classmates. As this is the very last input to this thread, you may take additional time as needed.

Participant. Respond to the facilitator's final discussion prompt.

Appendix E

Survey

IRB Approved Student self-report of educational leadership experience.

This is a copy of the informed consent document you signed prior to receiving the e-mail link to this survey. It is included here for your review. (ELECTRONIC SURVEY) PARTICIPANT INFORMED CONSENT for a Research Study entitled "Patterns of knowledge co-construction in an online educational leadership course".

You are invited to participate in a research study. I am asking you to participate in a research study titled "Patterns of knowledge co-construction in an online educational leadership course." I will describe this study to you and answer any questions that you may have. The study is being conducted by James N. Slear. The faculty advisor for this study is Ellen Reames, Professor in the Auburn University Department of Educational Foundations, Leadership, and Technology.

What this study is about: The purpose of this research is to examine the relationships and patterns of interaction associated with the social co-construction of knowledge in an online educational leadership course. The researcher's intent is to further understand how to improve the quality of peer-to-peer interaction in online learning. You were selected as a possible participant in this research study because of your present enrollment in EDLD 8210 and because you age 19 or over.

What I will ask you to do: If you agree to participate in my research, I am asking for you to complete an electronic survey titled "Student self-report of educational leadership experience" The survey will ask you to rate your level of experience with 25 topics common to educational leadership, It will also you how many years of experience you have in different administrative and leadership capacities.

Risks and discomforts: Breach of confidentiality is the risk associated with participating in this research study due to the use identifiable data. To minimize this risk, I will replace your names with arbitrary two-letter identifiers once I download the results. The use of the electronic data sent via email presents no greater risk than everyday use of the Internet. There is also the risk you may feel coerced or socially pressured into participating. To minimize this risk, I will not share the status of your participation with the course instructor until after final grades are assigned. Further, since I am collecting consent forms, you may turn in a blank form or you may simply ask me to withdraw privately at any time. Although I am a course TA, I do not grade any assignments.

Benefits. If you participate in this study, you can expect no direct benefits. However, an indirect benefit is that information from this study may be used to benefit future online courses. I cannot promise that you will receive the receive the benefit describe.

Compensation for your participation: There will be no compensation offered.

Costs involved: There are no costs related to your participation in this study.

Privacy/Confidentiality/ Data Security: Your privacy will be protected. Any data obtained in connection with this study will remain confidential. The researcher will not use any personally identifying information in the analysis or presentation. The use of Qualtrics for the electronic

survey presents no greater risk than everyday use of the Internet. No email or IP Addresses will be collected from the web server. The findings of this research will be used to fulfill an educational requirement for a dissertation; and may also be used to create presentations or publications.

Taking part is voluntary and you may withdraw at any time during the study. You may refuse to participate before the study begins. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University, Department of Educational Foundation, Leadership, and Technology or those people involved in this study.

If you have questions: If you have questions, you may contact Dr. Ellen Reames at reamseh@auburn.edu or James Slear at jns0048@auburn.edu. If you have questions regarding your rights as a subject in this study, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

The Auburn University Institutional Review Board has approved this document for use after 08/08/2019. Protocol #19-258 EP-1908.

Click arrow below to begin survey.

Q6 Write your full name _____

Q5 How many years have you worked as an educator? _____

Q4 How many years have you worked as an administrator (principal, assistant/vice principal, central office)? [Enter '0' if none] _____

Q3. How many years have you worked in a school leadership position (lead teacher, instructional coach, department chair)? [Enter '0' if none] __ On a scale of 1-6 (where ‘1’ is none at all and ‘6’ is extensive), rate your level of experience concerning each of the following educational leadership topics or contexts. Your level of “experience” for a given topic or context can be thought of as the degree to which you have read/researched it and/or the degree of direct engagement you’ve had in it as an educator

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)
Managing after-school programs (1)	O	O	O	O	O	O
Program oversight across multiple schools (2)	O	O	O	O	O	O
Program Budget Management (3)	O	O	O	O	O	O
Efforts to improve standardized test scores (4)	O	O	O	O	O	O
Interfacing with district/central office (5)	O	O	O	O	O	O
Charter schools (6)	O	O	O	O	O	O
Teacher favoritism (toward students) (7)	O	O	O	O	O	O
Student classroom placement policy/procedure (8)	O	O	O	O	O	O
Faculty/staff hiring (9)	O	O	O	O	O	O
Federally-mandated de-segregation (10)	O	O	O	O	O	O
Rural schools (11)	O	O	O	O	O	O
Urban Schools (12)	O	O	O	O	O	O
Turn-around school leadership (13)	O	O	O	O	O	O

Service on committees or task forces (14)	O	O	O	O	O	O
Literacy/teaching reading (15)	O	O	O	O	O	O
School safety (16)	O	O	O	O	O	O
Parent teacher organizations or associations (17)	O	O	O	O	O	O
Magnet schools (18)	O	O	O	O	O	O
New teacher mentoring (19)	O	O	O	O	O	O
Direct engagement with school boards (20)	O	O	O	O	O	O
Care of special needs students (autism, ADD ADHD, etc) (21)	O	O	O	O	O	O
Schools with low staff turnover (22)	O	O	O	O	O	O
STEM/robotics competition (23)	O	O	O	O	O	O
Student leadership (24)	O	O	O	O	O	O
School finance (25)	O	O	O	O	O	O

Appendix F

Interaction Analysis Model

Interaction Analysis Model

As discussed in Chapter 2, the interaction analysis model (Gunawardena et al., 1997) is a content analysis tool designed to evaluate online discussion transcripts for evidence of social knowledge co-construction. The scale has five levels and each level is marked by 3-5 sublevels. Although the scale is ordinal, researchers have used the sublevels to justify treating it as continuous (Buraphadeja, 2010; Heo, Lim, & Kim, 2010; De Wever et al., 2010; Hull & Saxon, 2009; Aviv et al., 2003). In the present study, research question 1 follows the example of these researchers and treats the scale as continuous when evaluating the dialogue between pairs of students. Research question 2 on the other hand used a ruleset, defined in Chapter 3, to measure individual contributions to co-construction and did not require any scale interpretation for the IAM. Table E1 describes models levels and sublevels as defined by Gunawardena et al. (1997) as well as the conversion of scale from ordinal to continuous.

Table E1. The Interaction Analysis Model

Description	Phase	Scale Score
Level 1: Sharing and comparing of information		
A statement of observation or opinion	[Phl/A]	1.1
A statement of agreement from one or more other participants	[Phl/B]	1.3
Corroborating examples provided by one or more participants	[Phl/C]	1.5
Asking and answering questions to clarify details of statements	[Phl/D]	1.7
Definition, description, or identification of a problem	[Phl/E]	1.9
Level 2: Discovery and exploration of dissonance or inconsistency		
Identifying and stating areas of disagreement	[Ph2/A]	2.2
Asking and answering questions to clarify the source and extent of disagreement	[Ph2/B]	2.5
Restating the participant's position, and possibly advancing arguments or considerations in its support by references to the participant's experience, literature, formal data collected, or proposal of relevant metaphor or analogy to illustrate point of view	[Ph2/C]	2.8
Level 3: Negotiation of meaning/co-construction of knowledge		
Negotiation or clarification of the meaning of terms	[Ph3/A]	3.1
Negotiation of the relative weight to be assigned to types of argument	[Ph3/B]	3.3
Identification of areas of agreement or overlap among conflicting concepts	[Ph3/C]	3.5
Proposal and negotiation of new statements embodying compromise and co-construction	[Ph3/D]	3.7
Proposal of integrating or accommodating metaphors or analogies	[Ph3/E]	3.9
Level 4: Testing and modification of proposed synthesis or co-construction		
Testing the proposed synthesis against "received fact" as shared by the participants and/or their culture	[Ph4/A]	4.1
Testing against existing cognitive schema	[Ph4/B]	4.3
Testing against personal experience	[Ph4/C]	4.5
Testing against formal data collected	[Ph4/D]	4.7
Testing against contradictory testimony in the literature	[Ph4/E]	4.9
Level 5: Agreement statements/applications of newly constructed meaning		

Summarization of agreement(s)	[Ph5/A]	5.2
Applications of new knowledge	[Ph5/B]	5.5
Metacognitive statements by the participants illustrating their understanding that their knowledge or ways of thinking (cognitive schema) have changed as a result of the conference interaction	[Ph5/C]	5.8