



8-2014

Instructional Change in Academic Departments: An Analysis from the Perspective of Two Environment-Focused Change Strategies

Kathleen M. Quardokus

Western Michigan University, kquardokus@gmail.com

Follow this and additional works at: <https://scholarworks.wmich.edu/dissertations>



Part of the Higher Education Commons, Higher Education and Teaching Commons, and the Science and Mathematics Education Commons

Recommended Citation

Quardokus, Kathleen M., "Instructional Change in Academic Departments: An Analysis from the Perspective of Two Environment-Focused Change Strategies" (2014). *Dissertations*. 312.

<https://scholarworks.wmich.edu/dissertations/312>

This Dissertation-Open Access is brought to you for free and open access by the Graduate College at ScholarWorks at WMU. It has been accepted for inclusion in Dissertations by an authorized administrator of ScholarWorks at WMU. For more information, please contact wmu-scholarworks@wmich.edu.



INSTRUCTIONAL CHANGE IN ACADEMIC DEPARTMENTS: AN ANALYSIS
FROM THE PERSPECTIVE OF TWO ENVIRONMENT-FOCUSED
CHANGE STRATEGIES

by

Kathleen M. Quardokus

A dissertation submitted to the Graduate College
in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
The Mallinson Institute for Science Education
Western Michigan University
August 2014

Doctoral Committee:

Charles Henderson, Ph.D., Chair
Megan Grunert, Ph.D.
Heather Petcovic, Ph.D.

INSTRUCTIONAL CHANGE IN ACADEMIC DEPARTMENTS: AN ANALYSIS FROM THE PERSPECTIVE OF TWO ENVIRONMENT-FOCUSED CHANGE STRATEGIES

Kathleen M. Quardokus, Ph.D.

Western Michigan University, 2014

Numerous reports demand changes in college and university teaching practices. This is especially true for science, technology, engineering and mathematics (STEM) disciplines. STEM stakeholders are concerned about student retention within STEM majors, as well as the lack of sufficient graduates with the knowledge to advance these fields. A common conclusion of these reports is that teaching practices must change. Although these calls for change have occurred for decades, STEM fields have yet to experience widespread change. Thus, there is a need for more effective change strategies. Recently, researchers have suggested that effective change strategies should focus on changing the environments of academic departments. This is in contrast to most commonly-used change strategies that focus on individual instructors. Environment-focused change strategies have two main varieties: those that have a goal of implementing prescribed outcomes, and those that expect the outcomes to emerge from the change process. Yet, little is known about how to enact environment-focused change strategies. The goal of this research is to provide guidance for change agents and researchers by analyzing a large-scale change initiative from the perspective of two environment-focused change strategies: Kotter's eight-stage leadership process (prescribed) and complexity leadership theory (emergent). This analysis was guided by

two research questions. 1. Within the context of a higher education change initiative, how is the change process described from the perspectives of two distinct leadership theories? 2. How do these descriptions frame problems and solutions associated with change? Each change strategy identified different activities as contributing to change as well as different missed opportunities. For example, when the change vision was not communicated effectively, the eight-stage leadership process indicated that the involvement of the department chair was needed, while complexity leadership theory indicated that more collaboration among individuals was needed. Often the missed leadership opportunities had been used effectively by one of the other departments. In addition to providing researchers and change agents with clear articulation of two ways of thinking about the change process, the results of this project identify four common problems that arose in the case studies and propose solutions from the perspective of each change strategy.

Copyright by
Kathleen M. Quardokus
2014

ACKNOWLEDGMENTS

I would like to thank several people without whom this dissertation and degree could not have been completed. First, Dr. Charles Henderson has provided endless hours of guidance and support. He has patiently directed my development as a researcher and a scholar. I will forever be grateful for the time he has committed to mentoring me.

I would also like to thank the members of my committee: Dr. Megan Grunert and Dr. Heather Petcovic. Their timely feedback on the research design and analysis has greatly enhanced this research project. In addition, the members of The Mallinson Institute for Science Education have been instrumental in providing advice and support throughout my time at Western Michigan University.

Finally, I would like to thank my family and friends who provided me with the emotional support that was necessary to complete this degree.

Kathleen M. Quardokus

TABLE OF CONTENTS

ACKNOWLEDGMENTS	ii
LIST OF TABLES	vii
LIST OF FIGURES	ix
CHAPTER	
I. PROBLEM STATEMENT.....	1
Introduction.....	1
Change Strategies.....	3
Problem Statement Summary	5
Research Questions.....	6
Definitions.....	7
II. LITERATURE REVIEW.....	8
Environment-Focused Change.....	8
Environment-Focused Prescribed Change.....	9
Eight-Stage Leadership Process.....	15
Environment-Focused Emergent Change	33
Complexity Leadership Theory	40
Theoretical Frameworks: Two Change Strategies	60
Comparison of the Eight-Stage Leadership Process and Complexity Leadership Theory	61
Conclusion	67
III. METHODS	68

Table of Contents – Continued

CHAPTER		
	Methodology	68
	Case Study Analysis	68
	Context.....	69
	Unit of Analysis	73
	Limitations and Role of the Researcher.....	75
	Data Collection	76
	Leadership Artifacts.....	79
	Interviews.....	79
	Teaching and Learning Survey	80
	Approaches to Teaching Inventory	80
	Instructor Demographics and Co-Teaching Assignments	81
	Social Networks.....	81
	Analysis.....	84
	Stage I	85
	Stage II.....	86
	Stage III.....	90
	Stage IV	91
	IV. RESULTS	93
	Instructional Change in Five Departments	94
	Department A.....	95
	Department B.....	110

Table of Contents – Continued

CHAPTER		
	Department C	122
	Department D	136
	Department E	152
	Change Process: Eight-Stage Leadership Process and Complexity Leadership Theory	169
	Challenges and Solutions	175
	Challenge Topic One: Creating a Vision that Matches the Needs and Expectations of the Department Members	181
	Challenge Topic Two: Motivating Members of the Department to Make Changes	185
	Challenge Topic Three: Build momentum by communicating information about change with department members	189
	Challenge Topic Four: Institutionalize Change by Creating an Expectation for Change to Continue or Transferring Change from One Instructor to Another	192
	Summary of Challenges and Solutions	194
	V. CONCLUSIONS AND IMPLICATIONS	197
	Conclusions	197
	Implications	200
	Researchers of Higher Education Instructional Change	201
	Change Agents in Higher Education	202
	Closing	204
	REFERENCES	206

Table of Contents – Continued

APPENDICES	212
A. HUMAN SUBJECTS INSTITUTIONAL REVIEW BOARD CORRESPONDENCE	212
B. SEMI-STRUCTURED INTERVIEW PROTOCOLS	215
C. TEACHING AND LEARNING SURVEY	227
D. DETAILED DEPARTMENT NARRATIVES.....	229

LIST OF TABLES

2.1 The eight-stage leadership process (Kotter, 1996)	17
2.2 The number of references that have cited prescribed change's leading researchers according to Google Scholar (2014)	18
2.3 Summary of the eight-stage leadership process with adaptations for higher education	32
2.4 Summary of complexity leadership theory's enabling leadership activities	59
2.5 The main components of the eight-stage leadership process and complexity leadership theory	63
2.6 Attributes of key characteristics in each change model.....	64
3.1 Data sources and collection dates	77
3.2 Summary statistics of the five social networks in year two.....	87
4.1 Individuals who will be discussed in department A's change narrative and their role in the change initiative.....	95
4.2 Summary of enacted and missed leadership activities in department A.....	108
4.3 Individuals who will be discussed in department B's change narrative and their role in the change initiative.....	110
4.4 Summary of enacted and missed leadership activities in department B.....	120
4.5 Individuals who will be discussed in department C's change narrative and their role in the change initiative.....	123
4.6 Summary of enacted and missed leadership activities in department C.....	134
4.7 Individuals who will be discussed in department D's change narrative and their role in the change initiative.....	137
4.8 Summary of enacted and missed leadership activities in department D.....	150

List of Tables -- Continued

4.9 Individuals who will be discussed in department E's change narrative and their role in the change initiative	153
4.10 Summary of enacted and missed leadership activities in department E	167
4.11 Enacted and missed leadership activities in the five academic departments	169
4.12 Challenges faced by each department.....	177
4.13 Attributes of key characteristics in each change model.....	179
4.14 Challenges in the process of change and examples of potential solutions	196

LIST OF FIGURES

2.1 Change strategies used in environment-focused prescribed change.....	11
2.2 The features of environment-focused prescribed change represented by the eight-stage leadership process.....	16
2.3 Change strategies used in environment-focused emergent change.....	40
2.4 The components of emergent environment-focused change related to the aspects of complexity leadership theory	42
2.5 The roles and organizational locations of administrative, adaptive and enabling leadership (Schreiber & Carley, 2008; Uhl-Bien et al., 2009; Uhl-Bien et al., 2007).....	44
2.6 The roles of enabling leadership in complexity leadership theory	51
3.1 Change initiative context	70
3.2 Faculty Learning Communities (FLCs) during the four years of the change initiative	72
3.3 Data collection timeline	78
3.4 Example of a social network survey from year three	83
3.5 Department A (year two) with subgroups (indicated by shape of the node) and one set of well-connected individuals with representation from each subgroup (nodes with visible labels)	89
3.6 Department A (year three) networks based on frequency of discussions	90
4.1 Teaching discussion network of department A in the beginning years	96
4.2 Discussion network of department A during the concluding years	101
4.3 Advice network of department A during the concluding years	101
4.4 Department B discussion network during the beginning years	112
4.5 Department B discussion network during the concluding years.....	114

List of Figures -- Continued

4.6 The discussion network of department C in the concluding years	128
4.7 Social network of department D in the beginning years.....	140
4.8 Discussion network of department D during the concluding years	143
4.9 Discussion network of department E in the beginning years	156
4.10 Department E advice seeking network in the concluding years	160
4.11 Department E teaching discussion network in the concluding years.....	161

CHAPTER I

PROBLEM STATEMENT

Introduction

The quality of undergraduate science, technology, engineering and mathematics (STEM) education is a concern of numerous stakeholders (e.g. Association of American Universities (AAU), 2011; National Research Council, 2012; The White House, 2009). These stakeholders are concerned with the learning outcomes of students in STEM courses and the attrition rates of STEM majors. Stakeholders also recognize that improving student learning in STEM courses will provide economic and societal benefits (e.g. O'Brien et al., 2013).

Many students leave STEM fields for other majors or careers (e.g. Hurtado et al., 2010). For example, Hurtado et al. (2010) studied completion rates of students (across different ethnicities) who chose to major in STEM disciplines at the beginning of their college careers and graduated with STEM degrees in four years. Asian American students had the highest four-year completion rate at 32.4%. In contrast, White students who chose a non-STEM major had the highest overall completion rate at 61.3%. The rates of STEM major completion in four years are considerably lower than all of the non-STEM major counterpart rates.

STEM major completion rates and the need to improve student learning are significant problems at a time when the nation is demanding an increase in the number of STEM graduates in order to build an economically competitive STEM workforce (AAU, 2011). Evaluations of these problems place much of the blame on the teaching practices of STEM faculty members (e.g. Daempfle, 2003; DeHaan, 2005; Kardash & Wallace, 2001; Seymour & Hewitt, 1997). The use of poor instructional techniques is not due to a lack of availability of research-validated teaching methods (e.g. Froyd, 2008; Prince & Felder, 2006; National Research Council, 2012). Rather, the classroom practices of many STEM instructors do not reflect these instructional techniques (Brainard, 2007; Pollock & Finkelstein, 2008). To lower attrition rates and to improve student learning, change initiatives have been designed to encourage the use of effective classroom practices to improve STEM education for all students.

For the purposes of this study, a *change initiative* is an organized effort to improve teaching practices. A *change agent* is a person or group of people who create change initiatives to increase the use of these practices by STEM instructors. A *change strategy* describes the activities that a change initiative uses to encourage change. Some change initiatives have strategies that focus on large-scale, structural systems, while others focus on disseminating specific teaching practices to new adopters through workshops or seminars (Henderson et al., 2011). According to DeHaan (2005), change initiatives in higher education should focus on the environment by creating a culture that promotes and supports excellence in teaching. The system suggested by DeHaan includes instructor training in teaching practices, as well as an internal systems that reward excellence in instruction.

In summary, stakeholders have been calling for improvements in STEM education for decades. Much of the blame has been placed on the teaching practices of STEM instructors. Change agents organize change initiatives with various strategies to help instructors learn and use research-based practices. With better teaching practices, it is expected that students will be retained within the STEM majors and graduates will be better prepared to contribute to the advancement of STEM disciplines. The goal of the research is to provide guidance to change agents about which strategies to use when designing change initiatives. The next section introduces the type of change strategies used in the research analysis.

Change Strategies

Change strategies in higher education have two defining qualities (Henderson et al., 2011). First, they target either individuals or environments as the focus of change. Second, they either have desired outcomes prescribed before the initiative begins, or desired outcomes emerge throughout the change initiative with the input of those individuals or groups involved in change. The four categories of change strategies are the combination of these two alternatives: (a) individual change with prescribed outcomes, (b) individual change with emergent outcomes, (c) environmental/structural change with prescribed outcomes, and (d) environmental/structural change with emergent outcomes.

In the past, most change strategies have focused on the individual as the unit of change (Henderson et al., 2011). These individual change strategies include prescribed outcomes (e.g. conference dissemination; Foertsch et al., 1997) or emergent outcomes

(e.g. instructor consultation; Hativa, 1995). Although these strategies have been used extensively, STEM has not experienced a widespread change of instruction practices (Henderson et al., 2012).

Recently, it has been suggested that environment-focused strategies will be more successful in achieving widespread change (e.g. DeHaan, 2005; Kezar, 2011).

Environment-focused change strategies have been developed and discussed within the organizational change and management literature (e.g. Kotter, 1996; Nonaka & Takeuchi, 1995) and more recently in the context of higher education instructional change initiatives (e.g. Graham, 2012). Both environment-focused emergent and environment-focused prescribed strategies have been successful in promoting changes in teaching in higher education (e.g. Gibbs et al., 2009).

To understand how these two categories apply to academic departments, it is necessary to identify specific, coherent strategies that can act as frameworks for analysis. Two change strategies, Kotter's eight-stage leadership process (prescribed) and complexity leadership theory (emergent), are specific, canonical articulations of change strategies focused on environments that are representative of their respective change categories. These strategies have been suggested as potentially useful for designing change initiatives (Kotter, 1996; Uhl-Bien et al., 2007). This research uses these two strategies as theoretical framework and analysis tools; Chapter II discusses these strategies in detail.

In summary, traditional change strategies have focused on changing individual behavior through activities such as conference presentations of new innovations or individual consultations. These types of strategies have not been effective in creating

widespread change. Instead, researchers suggest focusing on environment-focused strategies. Environment-focused change strategies have been used in other organizations, but are relatively new to change in higher education. Both prescribed and emergent change has been successful in promoting effective teaching practices. The implications from this research provide change agents with information about how to use these strategies to think about change and to identify potential solutions.

Problem Statement Summary

STEM stakeholders have been calling for improvements in STEM education for decades. Much of the blame has been placed on the teaching practices of STEM instructors. Many research-based instructional strategies have been developed and shown to increase student retention and learning. Change initiatives are designed by change agents to encourage the use of research-based instructional practices. These change initiatives use specific strategies that are based on assumptions about the process of change. Traditional strategies have focused on changing individual behavior through activities such as conference presentations of new innovations or individual consultations. These types of strategies have been ineffective in creating widespread change. Researchers suggest that environment-focused strategies should be used more commonly.

Both prescribed and emergent environment-focused strategies have been successful in higher education. Change agents in higher education need guidance to understand how different contexts are informed by these strategies. This research uses

two specific change strategies, the eight-stage leadership process and complexity leadership theory, to analyze a case study of a change initiative involving five academic departments in a single research university. These specific strategies will be discussed in detail in the literature review of Chapter II. With an understanding of how to design successful change initiatives, change agents will influence widespread use of research-based teaching practices. Better teaching practices have been shown to improve student retention and learning, which are crucial concerns of STEM education stakeholders.

Research Questions

The significance of this study to STEM education is improved understanding of change strategies in higher education that focus on changing environments and structures. This knowledge is expected to contribute to creation of change initiatives that improve instructional techniques and student learning outcomes. The research is guided by the following research questions:

- 1) Within the context of a higher education change initiative, how is the change process described from the perspectives of two distinct leadership theories?
 - a) What does the eight-stage leadership process identify as enacted leadership activities?
 - b) What does the eight-stage leadership process identify as missed leadership opportunities?
 - c) What does complexity leadership theory identify as enacted leadership activities?

- d) What does complexity leadership theory identify as missed leadership opportunities?
- 2) How do these descriptions frame problems and solutions associated with change?

Definitions

Change Agent(s): a person or a group of people who hope to increase the use of research-based practices by STEM instructors.

Change Initiative: organized effort to improve teaching practices.

Change Strategy: the coordinated use of specific activities within a change initiative.

Environment-focused Change Strategy: a change strategy that focus on changing the environments and/or structures of higher education, expected to be the most effective in creating widespread change.

CHAPTER II

LITERATURE REVIEW

This literature review focuses on change strategies that seek to create changes in undergraduate teaching via changes in environments and structures. This includes environment-focused prescribed change and environment-focused emergent change. The goal of this review is to identify current practices in higher education change research, as well as organizational change practices that show promise for application in higher education. This literature is used as a guide to identify one strategy from each category that will be used to inform the analysis of this research project. These strategies (eight-stage leadership process and complexity leadership theory) are reviewed individually and then compared to each other to guide the case study analysis as theoretical frameworks.

Environment-Focused Change

Researchers believe that a structural shift towards valuing and supporting instructional practices will lead to widespread change in teaching practices (e.g. Kezar, 2011; Mervis, 2013). Changing the environment causes individuals to adjust their behaviors to align with the new structures. For example, many researchers suggest that change in teaching practices will only occur if tenure guidelines include more recognition for teaching accomplishments (e.g. DeHaan, 2005; Seymour, 2001). This change in the

guidelines for promotion would not directly demand change of the individual; however, individuals interested in attaining tenure will change their behaviors accordingly. This same process would also happen when changes occurred in norms or culture. Individuals would align their behaviors with the expectations of their colleagues. Change initiatives can be developed to create change in the environment. These initiatives may have some of the same strategies as individual change (such as conducting workshops e.g. Morgan & Roberts, 2002); however, they also include strategies aimed at changing the environment of higher education (such as creating a vision of the future state of instructional practices e.g. Quinn et al., 2012).

Henderson et al. (2011) identified two categories of environment-focused change: emergent and prescribed. In this section, the literature in each category is discussed. From this discussion, the main features of each category are identified as well as lessons-learned from change initiatives within these categories. Finally, two change models are identified with specific strategies that change agents can use to create change initiatives. These specific strategies are the eight-stage leadership process (Kotter, 1996) from prescribed change and complexity leadership theory (Uhl-Bien et al., 2007) from emergent change. These strategies are the theoretical frameworks of this research project.

Environment-Focused Prescribed Change

Henderson et al. (2011) refers to environment-focused prescribed change as policy change. Policy change approaches often adopt strategies from organizational change of businesses or other institutions (e.g. Graham, 2012). These attempts at change include activities such as creating and promoting a vision, and monitoring and

encouraging compliance to the changed policy (e.g. Barth, 2013; Elton, 2003). The goal of these activities is to plan and manage change (Kotter, 1996).

The role of the change agent is designing and implementing the activities of the change initiative. Many of the activities used in higher education environment-focused prescribed change are the same across multiple initiatives. For example, Barth (2013) argues change requires: a vision, a need for change, resources for support of changes and communication of short-term accomplishments. Elton (2003) agrees that innovations must meet the stakeholders' needs and vision is important to develop with collaboration from stakeholders. Fink et al. (2005) argues that leaders must set clear goals, provide extrinsic motivation, and shape cultural changes. The agreed upon activities of environment-focused prescribed change in higher education are setting a vision for the change initiative, aligning the vision with the needs of the stakeholders, and motivating individuals to meet these goals (with resources, intrinsic motivation, or extrinsic motivation) (Figure 2.1). The following subsections discuss these steps. The first section, creating a vision, includes developing the vision that meets the needs of members of the group. The second section, motivating individuals to change, includes using resources and rewards to encourage individuals to follow the vision.

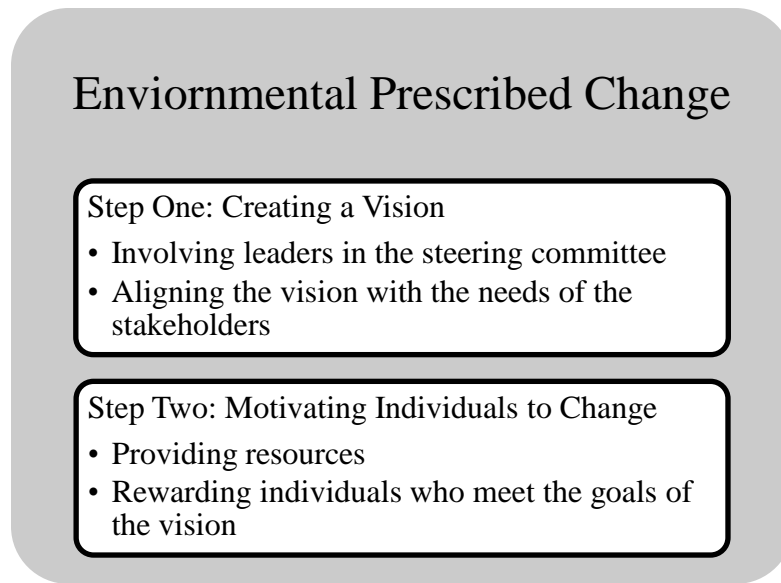


Figure 2.1 Change strategies used in environment-focused prescribed change

Creating a Vision

The vision for environment-focused prescribed change guides the development of activities. Creating a vision for a change initiative includes deciding who develops a vision and how the vision is communicated. De la Harpe and Thomas (2009) conducted a survey of individuals interested in sustainability change in higher education. From this survey, the authors concluded that developing a vision should be the responsibility of a steering committee. This group of individuals is strategically chosen to include leaders. Furthermore, this coalition requests input from other stakeholders to ensure the vision meets the needs of as many people as possible. Barth (2003) found that successful change initiatives were those that originated with the leaders of the university because they could provide support of organizational change.

Leaders should develop vision that meets the needs of the organization. Leaders are important to involve in the vision because they have the authority to plan activities to meet the goals of the vision. In order to align the vision with the stakeholders, leaders should be aware of the needs that are facing the members of the organization.

Motivating Individuals to Change

Once the vision and activities are in place, the leaders of environment-focused prescribed change must motivate and monitor compliance to the new policies. Changing activities to meet the goals of the vision can be difficult. Resistance can come from the every level of the organization (Elton, 2003). Leaders may resist promoting the vision and members of the organization may resist making changes.

Elton (2003) argues that both rewarding accomplishments and punishing non-compliance could motivate change. From his case studies of successful higher education curriculum change, he suggests punishments were not as successful at encouraging change because they did not allow for “buy-in” from participants. Instead, rewarding accomplishments had more success in encouraging changes in teaching practices. Elton found that in the beginning rewards were significant enough for faculty to continue to be involved in change, but as time progressed the rewards were not enough to maintain change. Elton argued that rewards systems that did not change caused faculty to return to focusing solely on conducting research to gain rewards.

The type of rewards needed for change in teaching practices was further articulated in case studies by Barth (2013) of higher education change initiatives. Barth argues that rewarding short-term accomplishments of the change initiative can build

momentum among potential participants. When colleagues see their peers rewarded for positive changes, they become more likely to be supportive of the change initiative. A limitation to Barth's suggestion is that he does not address how these short-term rewards translate into long-term rewards.

Rewards are not the only way to motivate compliance. Providing resources for individuals to implement change can reduce resistance. This can range from technology in the classroom to providing funds to attend workshops to learn about change. It is important for the type of resources available to meet the perceived needs of the faculty. De la Harpe and Thomas (2009) suggest allocating rewards to specific implementation tasks to ensure their use.

In summary, rewarding short-term and long-term wins motivates individuals to make changes to meet the vision. Recognizing STEM instructors that make appropriate changes encourages their peers to also make changes. Resources motivate individuals to change because it is easier for individuals to make the required changes. The change initiative is successful when all the members of an organization have changed.

Summary and Critique of Environment-Focused Prescribed Change

The approaches of prescribed change require the leadership to follow specific steps to manage the change process. The most common steps include developing a vision and motivating individuals to follow the vision. The leadership of the organization develops the vision. The vision should meet the needs of as many stakeholders as possible. Vision that is not supported by the leadership will not have the proper resources and support for large-scale change. Vision that is not supported by the members of the

community will meet resistance to change. Motivation for implementation of the vision must include rewards for small-scale achievements, maintain rewards throughout the process, and provide resources to support change.

A limitation in the design of studies of change in higher education is their focus on change initiatives that already have been completed. In general, research is often conducted in retrospect instead of throughout the process (e.g. Barth, 2003). When change is evaluated during the process, the research methods are not as well defined (e.g. Quinn et al., 2012). Methods used to identify successful patterns after the initiatives have been completed may be difficult to apply during the process of change. This area of research would benefit from evaluating change that is in progress with carefully planned methods. This should include the process from the perspective of those involved in change and those who are not involved in change to gain a clearer picture of how processes of change evolve.

An environment-focused prescribed change initiative should include creating a vision to meet the stakeholders' needs and implementing activities to meet this vision. Change agents need specific guidelines for designing this type of initiative. The following section identifies a specific change strategy that can be used by higher education to plan environment-focused prescribed change. This specific strategy will encompass the features identified here (vision and motivating change) and be used as a theoretical framework for the research.

Eight-Stage Leadership Process

Environment-focused prescribed strategies are effective methods for accomplishing change in higher education. The goal of this section is to describe a single environment-focused prescribed strategy that can inform studies of change in higher education. The chosen strategy is the eight-stage leadership process developed by Kotter (1995, 1996). This process provides a guideline for leaders to plan and manage successful change.

Several reasons make Kotter's eight-stage leadership process a good representative of environment-focused prescribed change. First, it includes all of the components of the environment-focused prescribed approach (de la Harpe, 2006). Environment-focused prescribed approaches should have a steering committee that creates a vision to meet the needs of stakeholders. The steering committee should recognize short-term and long-term accomplishments of members of the organization and support members in their efforts to meet the vision. The eight-stage leadership process includes all of these features: steering committee, vision, accomplishment recognitions and support (Figure 2.2). The first four stages develop and communicate vision and the final four stages implement change through resources and rewards (Kotter, 1996). Table 2.1 provides more description for each of the eight stages.

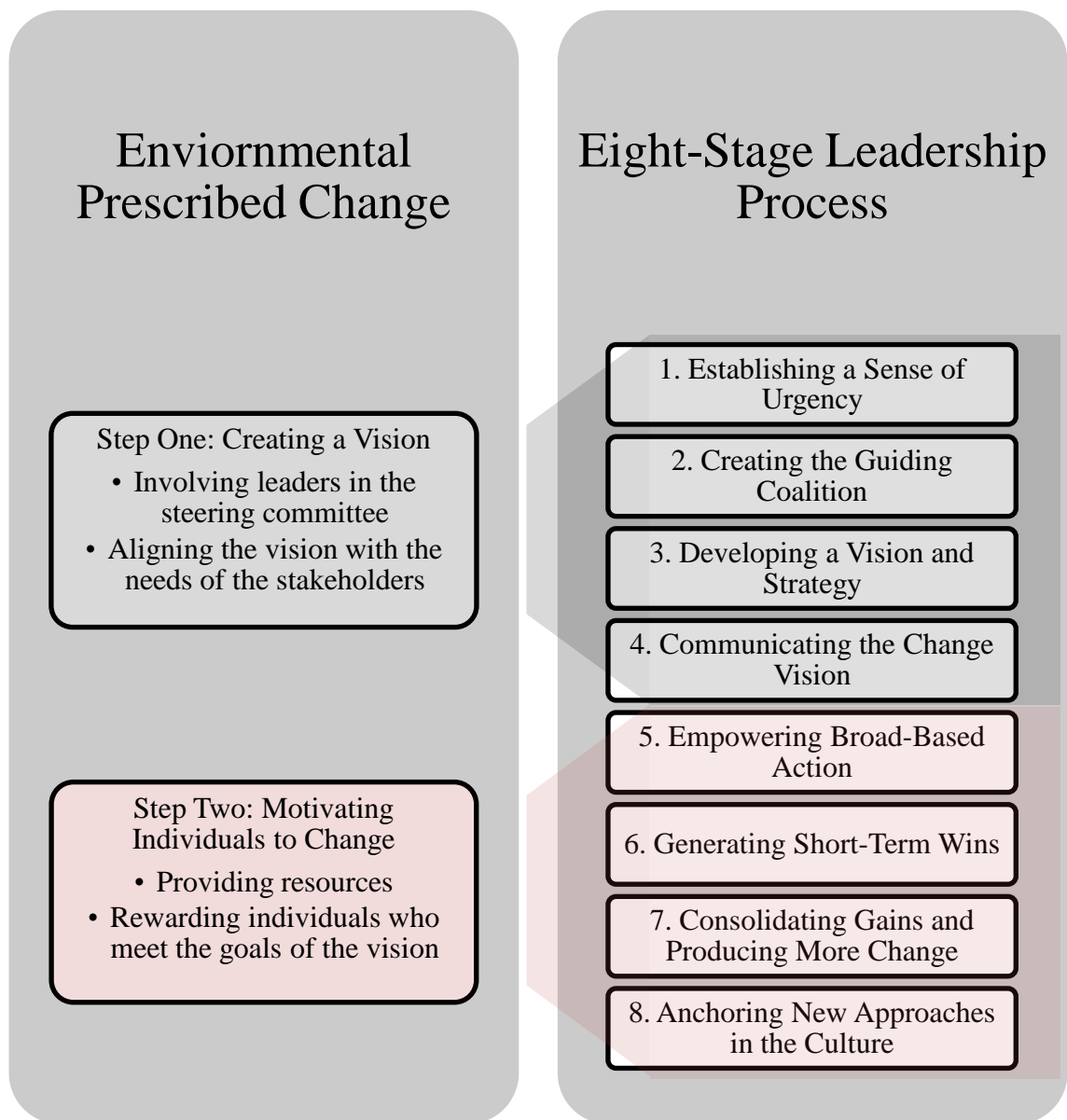


Figure 2.2 The features of environment-focused prescribed change represented by the eight-stage leadership process

Table 2.1 The eight-stage leadership process (Kotter, 1996)

Stage	Description
1. Establishing a Sense of Urgency	The change agent convinces the organization that the only reasonable response to a threat is widespread change.
2. Creating the Guiding Coalition	The change agent recruits powerful leaders to create the change initiative. This should include most of the high-level managers.
3. Developing a Vision and Strategy	The guiding coalition creates a vision. The vision should meet the needs of the stakeholders and address the sense of urgency.
4. Communicating the Change Vision	The guiding coalition continually communicates the vision to the organization and acts as role models of change.
5. Empowering Broad-Based Action	The guiding coalition provides resources and rewards to the members of the organization for making appropriate changes.
6. Generating Short-Term Wins	The guiding coalition creates situations that will lead to early successes. The leadership communicates these successes to the organization to maintain motivation to change.
7. Consolidating Gains and Producing More Change	The guiding coalition pushes the change initiative to address new, untouched areas of the organization.
8. Anchoring New Approaches in the Culture	The leadership integrates changes with the culture and systems of the organization.

Second, the eight-stage leadership process is a well-known approach to organizational change. Historically, prescribed change originated with a three stage model developed by Lewin in 1947 (Burnes, 1996). Since then, leading researchers in this field (Cumming, French and Bell, and Kotter) have expanded upon this model (Burnes, 1996). A Google Scholar search indicates that these researchers have been cited extensively (Table 2.2) (Google Scholar, 2014). The eight-stage leadership process has

been cited the most, indicating that it is a good choice to outline in detail for future use in change in higher education.

Table 2.2 The number of references that have cited prescribed change's leading researchers according to Google Scholar (2014)

Book or Chapter	Citations
Kotter (1996)	5,602
Cumming and Worley (2009)	3,481
Lewin (1947)	3, 317
French and Bell (1973)	2,315

Third, many researchers interested in education change use the eight-stage leadership process. This is particularly true for the area of engineering education research (Graham, 2012). For example, Quinn et al. (2012) used the eight-stage leadership process to evaluate the change process of engineering coursework from online classes to blended classrooms.

These three reasons (encompassing the aspect of environment-focused prescribed change, widespread use in organizational change, and use in engineering education change) led to the decision to focus on the eight-stage leadership process to represent environment-focused prescribed change. The next section is a description of the eight-stage leadership process. This is followed by lessons-learned in higher education using this model. Finally, gaps in the literature are identified as areas of future research.

Description of the Eight-Stage Leadership Process (Kotter, 1996)

Kotter developed his eight-stage model based on his experience with evaluating change in large and small organizations. Throughout all of these change initiatives, Kotter identified eight common mistakes that were hindrances to change. To help future change agents avoid these mistakes, Kotter developed his eight-stage process such that each stage corresponds to a common mistake. The eight-stage leadership process is meant to be followed in a step-by-step manner. Success in an earlier step is necessary before moving to the following step.

Developing a sense of urgency is the first step of the process. This step sets the stage for vision creation. The change agent must make the status quo not only seem outdated, but actually more dangerous than attempting change. This step requires strong leadership to sell the need for change. In order for this step to be successful, Kotter estimates that at least 75% of the leadership must believe “business as usual” is completely unacceptable. Kotter suggests that it may be easiest to use outside forces to communicate the strength of this message, such as external review committee or student evaluations. For example, industry may create a sense of urgency for higher education by demanding a different type of graduate. Ensuring that all areas of the organization acknowledge the need for change is the main feature of this step.

In the second step of the process the change agent creates a guiding coalition. This coalition should include senior managers. The coalition will start small in the beginning of change but then will grow larger and larger as change spreads throughout the organization. It is important for this guiding coalition to involve influential, powerful leaders. In higher education, these powerful leaders are likely chairs in the department

and individuals who have expert knowledge. The more formal power that the individual has to influence structures of the university; the more important it is for the change agent to include him or her in the guiding coalition.

In the third step, the guiding coalition develops a vision and strategy. Throughout this process, Kotter stresses that it will take time to change. The change agents must not move on to the next step before completing the previous step. The single step of creating a vision may take three to twelve months of careful deliberation and design by the guiding coalition. The vision is complete when it creates understanding and interest within the organization. The guiding coalition should be able to explain the vision within a three to five minute communication. If it is too complicated it will be difficult to spread the vision outside of the guiding coalition. In higher education, an example of a vision may be graduating students with an increased ability to think critically. The vision should correlate with the sense of urgency. For example, critical thinking may be important to employers who are demanding a change in the training of graduates. The guiding coalition uses the vision to determine what strategies should be instated to meet its goals.

Communicating the change vision to the organization is the fourth step. The guiding coalition must communicate through multiple messages. Interactions with members of the coalition should continually reference the vision. This includes meetings, memos, emails, and discussions. Furthermore, the leadership of the guiding coalition should not just “talk the talk” but also “walk the walk.” It is important for the leadership to embody the vision and to lead by example. In higher education, this may mean that the leadership changes how their classes are taught and pilots ideas that are important to the vision.

The fifth step is empowering broad-based action. This step represents a change from preparation for change to enacting the planned change. The goal is to involve as many people in change as possible. Once members of the organization begin to make changes, the guiding coalition should work to remove barriers to change. It is not possible to remove all barriers, but to be successful the guiding coalition must remove the major challenges. A barrier could be a particular person who is resistant to change. If this person is in a position of power, this barrier could endanger the entire change initiative. Barriers may also be contextual. Providing resources for change and rewarding successful change should help remove contextual barriers. In higher education, guiding coalitions might empower others to act on the vision by providing training in instructional techniques.

The sixth step is generating short-term wins. It is important to keep members of the organization excited and engaged in change. This happens by actively creating short-term successes and celebrating them within twelve months of the start of changes. Creating short-term wins helps the organization avoid the loss of motivation that can occur because change takes several years. The guiding coalition should link these accomplishments to the change efforts, so that resisters cannot deny its success. Creating short-term wins may include assessing student outcomes of a pilot study and disseminating the results.

The seventh step is consolidating gains and producing still more change. Declaring victory too early is the mistake that this step is meant to avoid. Once short-term successes are recognized, the change initiative should tackle bigger untouched areas of the organization. If the guiding coalition stops promoting change, it is likely that the

short-term successes will return to their original state. In higher education, this step may look like expanding change to all courses offered by a department or partnering with a new department to create institute-wide change.

The eighth step of change is anchoring new approaches in the culture. The guiding coalition should identify and communicate the links between the change initiative and organizational successes. This helps the members of the organization value the changes promoted by the guiding coalition. This step also includes convincing the next generation of management and leaders to embody the vision. In higher education, this step may include making links of success and change clear to the new department chair.

According to the eight-stage leadership process, careful planning and management throughout the change initiative is necessary to achieve success. Change is driven by a guiding coalition of powerful change agents. This power may be from position or reputation. The process takes a considerable amount of time. The process concludes when the culture of the organization includes the vision. The following section investigates how these eight steps have been used to inform change in higher education.

Eight-Stage Leadership Process in Higher Education

Where the previous section gave suggestions of what the eight-stage leadership process might look like in higher education, this section provides empirical evidence. Three types of scholarly writings reference Kotter's model. Articles of the first type suggest the eight-stage leadership process as a guide for future research (e.g. Fink et al., 2005). These authors recognize a current problem in education that structural change can

fix. They suggest application of the eight-stage leadership process as a solution to the problem. Next, some researchers have used the eight-stage process to plan and execute change initiatives (e.g. Froyd et al., 2000; Morgan & Roberts, 2002). These researchers may have used the eight-stage leadership process from the beginning of their project or may have turned to it through the evaluation process. These studies focus on a single change initiative. Finally, evaluations of multiple change initiatives use the eight-stage leadership process as a theoretical framework (e.g. Graham, 2012). The topics of the three types of writings range from change in instructional practices due to involvement in professional development (Fink et al., 2005) to large-scale curriculum change (Graham, 2012).

Eight-stage leadership process as a guide for future research. Authors in this category identify successful change in other disciplines that used the eight-stage leadership process and suggest how higher education can benefit from its application. For example, Robert Diamond, the President of National Academy for Academic Leadership, wrote a book chapter focusing on how the eight-stage leadership process could inform all types of education change (Diamond, 2005). He suggests that in order to follow the process, institutions must develop experts from within the organization. He believes that consultants and outside experts will not be effective for the long-term change that academics need. He suggests the development of a center of change with expertise in education practices and organizational change. This center would be part of the university and used for many different types change initiatives across the institution (Diamond, 2005).

In contrast to Diamond's broad approach to change, some change agents apply the eight-stage leadership process to specific challenges in higher education. Fink et al. (2005) studied the transfer of professional development training to large-scale change. Through two anecdotal examples of change, Fink et al. suggest that professional development is more successful when the guiding coalition consists of college deans and department chairs. Kotter suggests that senior management is important for successful change, but the hierarchy of organizations is not exactly the same as higher education. This may make Kotter's suggestion difficult to interpret. Fink et al. suggest (anecdotally) that this senior leadership is the department chair and deans of the institution.

These researchers suggest that applying the eight-stage leadership process to change in higher education requires some interpretation. They suggest modifications to stage two. The guiding coalition leaders should be experts in the area of education and organizational change, and members of the university community (possibly deans and chairs). A current limitation to these ideas is their lack of empirical support. However, in the next section, lessons-learned from applying the eight stages to the development or evaluation of a single change initiative is discussed.

Eight-stage leadership process for informing a single change initiative. In these studies, the leaders of the change initiatives hope to improve their approach to change through application of the eight-stage leadership process. They may have used the eight-stage leadership process to design the initiative or as an evaluation tool to identify areas of improvement. Many times these articles informally used the eight-stage leadership process to inform their design or evaluation. Articulating formal methods for applying the

eight-stage leadership process is an area of future research for application of this strategy to higher education.

An example of this type of application is the study by Abenga (2009) that used the eight-stage leadership process to train faculty members in pedagogy techniques. This training consisted of three phases. First, the change agents sensitized the faculty members to the need for change through a one day workshop (establishing a sense of urgency). Next, faculty members completed a two week course in curriculum development (planning, implementing and assessing student learning) and teaching strategies (providing resources for change). Finally, faculty implemented changes in their classroom and shared these changes with others. Abenga concluded that an important part of developing a sense of urgency and setting a vision was sensitization to the need for change through the one day workshop. Before the workshop, Abenga found that many science faculty members believed that strength in content knowledge was all that was necessary to be an effective teacher. The one day workshop addressed this misconception and helped increase motivation to change by creating a need for change before the initiative began.

In applying the eight-stages to a curriculum change initiative, Froyd et al. (2000) make specific suggestions on how to adapt the eight-stages to higher education. For example, in stage three, developing a vision and strategy, curriculum change initiatives should focus on developing new learning objectives and classroom environments. This articulates how higher education change might form a strategy of implementing the vision (by focusing on learning objectives). Furthermore, in stage five, Froyd et al. suggest using a pilot study to empower broad-based action. These adaptations assist

change agents in interpreting the eight-stage leadership model for higher education contexts.

Morgan and Roberts (2002) used the eight-stage leadership process as an evaluation tool during the process of change. The changes proposed by Morgan and Roberts included an institution-wide move from teacher-focused to student-focused teaching strategies, a restructuring of curriculum to reduce the number of courses offered, an increase in flexibility of students' programs of study, and an articulation of the desired learning outcomes for all graduates. The guiding coalition formed faculty teaching teams to address the needed changes. They provided deadlines by which faculty teams had to implement the appropriate changes. Morgan and Roberts assessed their approach to change and articulated areas where it could be improved. The authors gave themselves a letter grade for each stage in the process. This was based on how they thought they had performed each step and evidence was given from the activities of the initiative. Like Abenga, they felt that their vision was poorly communicated and actively opposed by some of the faculty members. Luckily, the strong leadership of the change initiative was able to require change of these individuals through institutional mandates. The authors fear that if some of the faculty members had been successful in opposing the change, it would have hindered all other faculty members' involvement in change. Just as suggested by Diamond (2005) and Fink et al. (2005), it was important to have deans and chairs involved in the guiding coalition in order to give power to the vision.

These studies suggest that creating a sense of urgency and vision are two of the most important steps to change. In curriculum change, the vision should include learning objectives and ideal classroom environments. This change is easier to accomplish when

deans and chairs are members of the guiding coalition. Short-term accomplishments can be identified through pilot studies of curriculum changes.

A limitation to these types of studies is that those involved in planning the change initiatives are also conducting the research. The authors may have bias towards concluding that their change is successful. Also, such as in Morgan and Roberts (2002), a limitation is that little detail is given about how the model was used as an evaluative tool. A benefit of this research is the ability to apply the findings immediately to the change initiative and make improvements while it is still in progress.

The following section examines the eight-stage leadership process as a framework to analyze change across multiple institutions. These types of studies are different than single change initiative methods because the research is not conducted by the change agents of the initiatives.

Eight-stage leadership process for evaluating multiple change initiatives. This type of research evaluates more than one change initiative with respect to the eight-stage leadership process. A benefit of this research is the development of themes of change across higher education. These themes can inform how change agents apply the eight-stage leadership process. Future studies that build upon this research should investigate how the new modifications to the eight-stage leadership process are present in specific case studies.

One of the modifications found by these studies is a suggestion to identify teams of teachers to reward in the sixth stage (generating short-term wins). De la Harpe (2006) analyzed the process of education change in three areas: a curriculum change project, a

student professional skills project and a communication in science project. The goal of this research was to investigate how change theories related to higher education. This included several change models, but it was concluded that the eight-stage leadership process encompassed all of the other models. The implications of the study were eight recommendations for change in higher education that were closely correlated with the eight stages of the leadership process. For example, the second recommendation was to develop higher education guiding coalitions with members who have the ability to effect change through their position, expertise, or influence. This includes individuals whose expertise gives them authority on the subjects of the change initiative. This modifies Fink et al.'s (2005) suggestion to focus on involving deans and chairs in the guiding coalition. Individuals with expertise may be deans and chairs but they also may be any level of department member. De la Harpe also modified the sixth step of the process, generating short-term wins. She recommends that successes should be team-based and not individualistic. She found that focusing on an individual's success did not translate well to achieving sustainability in environment-focused change.

One of the recommendations made by de la Harpe is not part of the eight-stage process. This is the recommendation to involve students in the change process. De la Harpe suggests that this is important to consider when the change initiative will affect the lives of the students. She suggests change agents should include students in all steps of the process: planning, implementing, evaluating, and modifying the change.

Another example of this type of research was a large-scale study by Graham (2012). In this study, Graham interviewed 70 experts involved in higher education change from 15 countries. One of the goals of these interviews was to identify well-known

successful examples of change in higher education for in-depth case studies. Graham identified four major points across six examples of change that can be used to inform the eight-stage process.

First, successful change was usually in response to a specific threat. The characteristics of the change agents modified the response to this threat. If the faculty change agents were newer, had previously been employed in industry, or had previously experienced a failure during an attempt to change, they were more likely to interpret the threat as a sense of urgency for widespread change. Graham concluded that having one of these three backgrounds led the change agent to believe that only widespread change would be effective in addressing the crisis.

Second, Graham found that more successful change occurred when the new systems were well integrated with the entire program. For example, if only a small portion of the curriculum changed, this portion had to have an impact on other areas of the curriculum to be successful. Change initiatives that were isolated from the core of the system or had only one or two champions of change were less likely to be successful. Graham suggests that a cross-section of faculty should be involved in change to keep it integrated with the system. Furthermore, this cross-section of faculty should approach change as teams, instead of as individuals. This provides further support for de la Harpe's (2006) suggestion that short-term wins should identify teams and not individuals.

Third, it was important to involve the head of the department in change, either as the leader of the change or as co-leader of the change. This corresponds to the creation of a powerful guiding coalition in the second step of the eight-stage process. Not only is it important to have a cross-section of individuals involved in change, the powerful leaders

should also be involved. This provides evidence in support of researchers' suggestions for applying the eight-stage leadership process to higher education by involving chairs and deans in change (e.g. Fink et al., 2005).

Fourth, Graham found that the test for sustainment of the change was turnover in the leadership of the department. If the new chair supported the change, then it was likely to become part of the structure of the department. This is an important for change initiative evaluators to note. It may be difficult to determine when change has been institutionalized. If a change in leadership happens and the change survived, this may indicate that change has been institutionalized. On the other hand, if change in leadership has not happened, evaluators should be more cautious in declaring that the initiative achieved this stage.

These multi-initiative evaluations suggest that strong leaders are important to change. Guiding coalitions need to include the deans and chairs of the department as well as a cross-section of individuals (stage 2, 5). Among these leaders, change agents should also involve students in change initiatives from the time of development through evaluation (stages 1-8). System integration techniques include engaging faculty in team-teaching and celebrating short-term wins of teams instead of individuals (stages 5-8).

A limitation of this type of study is the large-scale approach. This approach usually is a snapshot of the change initiative and does not evaluate the dynamics of change. For example, if participants are interviewed after change is completed, they may have forgotten some of the details or intermediate steps that were taken to achieve change. A benefit of this type of research is the identification of themes that inform the application of the eight-stage leadership process in higher education. Evaluations of



individual change initiatives can expand upon these findings by providing an in-depth analysis of how these features affect change in higher education.

Summary of the Eight-Stage Leadership Process

Applying the eight-stage leadership process of change has included suggesting its use, planning and evaluating single change initiatives, and evaluating multiple change initiatives. These researchers have found that the eight-stage leadership process is useful in explaining the reasons for successes and failures of change initiatives in higher education.

Modifications to the eight-stage leadership process for change in higher education include: involving a cross-section of stakeholders (faculty, deans, chairs, and students) in the guiding coalition (stage 2), focusing on learning objectives and classroom environments of curriculum change initiatives (stage 3), empowering broad-based action through pilot studies and celebrating team wins (stage 6), and integrating change to the system through team teaching (stage 8). The test of this success is often the ability of change to survive a transfer of formal leadership of the department. Table 2.3 lists the modifications to the eight-stage leadership process.

Table 2.3 Summary of the eight-stage leadership process with adaptations for higher education

Eight-Stage Leadership Process (Kotter, 1996)		
Change is episodic, with a clear beginning and end		
Create Vision (1-3)		Implement Change (4-7)
		Institutionalize Change (8)
<ol style="list-style-type: none"> 1. Establishing a sense of urgency 2. Creating the guiding coalition (include deans, chairs, cross-section of faculty, and students) 3. Developing a vision and strategy (focus on learning objectives and classroom environment) 4. Communicating the change vision 5. Empowering broad-based action (team-teaching) 6. Generating short-term wins (use pilot studies and reward teams of instructors) 7. Consolidating gains and producing still more change 8. Anchoring new approaches in the culture (use co-teaching assignments) 		

The next step in this area of research is to expand upon the methods used to evaluate single change initiatives with the knowledge of these modifications. This research should look for these characteristics throughout the process of change to provide details of if and how they manifest themselves during the change initiative. It will also be important for this research to develop rigorous methods for applying the eight-stage leadership process as a theoretical framework.

The next section returns to the category of environment-focused emergent change. This topic follows the same structure as the prescribed change category. First, environment-focused emergent change in higher education is summarized. Next, a specific example from this category is reviewed in detail.

Environment-Focused Emergent Change

Environment-focused emergent change is based on the idea that change cannot be controlled (Uhl-Bien et al., 2007). Instead, a change initiative facilitates the conditions that are most likely to lead to productive change. For example, Plowman et al. (2007) investigated the role of leadership in an urban church transformation. In this example, a few of the parishioners developed a free Sunday morning breakfast for the local homeless population. These parishioners saw a need in the community and created a local change to meet this need. The leaders of the church recognized that this change was successful in bringing new life into the church. The leaders facilitated conditions to amplify this local change to organization-wide change by acknowledging it at church meetings. This provided a platform for all parishioners to learn about the change and to discuss its organization-wide implications. The dialogue created by the leaders led to the amplification of the change. Eventually, the identity of the church transformed into a mission for serving the homeless population. The leaders of this church used environment-focused emergent change by opening up discussion about the local change. This provided language for the parishioners to discuss the change and to develop a shared vision of change.

Henderson et al. (2011) describe environment-focused emergent change as developing a shared vision. The needs and ideas of the members of the organization shape the vision. The vision is flexible and can change when the needs of the organization change (Plowman et al., 2007). This is different than environment-focused prescribed change because it does not rely on a small leadership team to decide and promote a vision to the organization. It allows the members of the group to determine the

desired future state of the organization. Henderson et al. (2011) found that this type of change was rarely attempted in higher education (only 16 of 191 reviewed articles were included in this category). For this reason, research in this section includes studies of organizational change in other types of institutions.

Environment-focused emergent change is facilitated rather than managed; it does not follow a systematic, step-by-step process (Eckel & Kezar, 2003). Facilitated change has activities that lead to conditions that encourage new ideas. This is not the same as unassisted change. Some leadership is needed to ensure that ideas that develop on the periphery of the group are distributed to the entire group. For example, Barth (2003) outlined three different successful changes in sustainability in higher education. In one instance, students led the sustainability changes. However, Barth found that student-led change was not as successful as leadership-led change. This may be because the student-led initiatives could not gain system-wide support without more engagement from the leadership.

The discussion of environment-focused emergent change strategies covers three features: the role of the participants, the role of the leadership, and the role of external influences. The role of the participants includes the development of shared vision and the creation of innovations. The role of the leadership includes openness to innovative change and distribution of innovations to the entire organization. External influences on change include environmental pressure on institutions to make changes. These areas should not be thought of as individual goals or steps, as in the eight-stage leadership process, but as simultaneous efforts that interact with each other throughout the change initiative.

Role of the Participants

For environment-focused emergent change, the people affected by change must be the people involved in developing change. This is imperative because the people within the organization have the most relevant expertise to make useful innovative change (Brigham, 1996). The job of the change initiative is to harness this potential by promoting discussion and deliberations among members of the organization (e.g. Kezar, 2011; Nonaka & Takeuchi, 1995). An individual knows how to operate within his position in the organization, but he may lack general understanding of how his role is important to other members of the organization. New ideas and innovation can emerge when people from diverse roles connect and share their perspectives.

Kressel et al. (1999) created an environment-focused emergent change initiative based on psychological consultation of academic departments. This self-study process used discussion to identify the expertise within the department and to encourage the creation of new knowledge. Kressel et al. suggest that with emergent change, it is important not to micro-manage individual relationships. Instead, once individuals are aware of the dynamics of their department, it is the participants' responsibility to make the necessary changes to create positive innovations.

The role of participants in environment-focused emergent change also includes interaction with the vision. The participants should support the vision and apply it to their actions and interactions with each other (Nonaka & Takeuchi, 1995). This connection between the vision and actions of the participants is reciprocal. The vision shapes the actions, and the actions shape the vision. Vision must be flexible and change to reflect the interactions between participants (Eckel & Kezar, 2003). The leadership facilitates this

change in the vision through communication with the members of the organization (Nonaka & Takeuchi, 1995).

Eckel and Kezar (2003) studied the process of transformative change in higher education institutions. They found that if more people became involved in change initiative activities, then the number of interactions increased. As interactions increased, the modifications to the vision also increased. This kept the vision aligned with the needs of the institution, and also helped the institute create a shared vision among all members.

Participants in emergent environment-focused change interact with one another to create new knowledge. This new knowledge modifies the vision of the organization. The vision of environment-focused emergent change must be flexible to accommodate the emergence of new ideas from the participants.

Role of the Leadership

The leaders of environment-focused emergent change often have to relearn what it means to be a leader (Brigham, 1996). Leaders do not develop vision or promote prescribed innovations; leaders connect individuals of the organization in order to understand the individuals' vision and support their positive ideas (Brigham, 1996).

Relying on interactions to develop knowledge can make the leaders vulnerable to criticism for violating the institution's expectations of the role of the leader. The leader should publicly recognize short-term accomplishments to gain support for this type of leadership (Kezar & Eckel, 2003). The leader can identify short-term accomplishments by discussing the process of change with participants. According to Nonaka and Takeuchi (1995), the responsibility of maintaining these discussions between participants

and the leadership is the role of the middle managers. These managers have the benefit of connections to the participants and to the high-level leaders. Researchers suggest that this middle management role may be filled by department chairs (e.g. Edwards, 1999; Senge, 2000). Therefore, the support of department chairs for change initiatives is important for environment-focused emergent change strategies.

To make this process of identifying new ideas and promoting them to the organization through a flexible vision, the leader must be open to innovative change developed by participants. Kressel et al.'s (1999) consultation study found that change was more successful in departments that had leaders who were open to criticism and suggestions. If the leaders were not open to change or criticism, than the ideas developed among the participants did not spread to the department.

Leaders of environment-focused emergent strategies facilitate change by creating interactions between participants. This interaction leads to knowledge creation. Middle managers communicate the knowledge created by the participants to the leaders of the organization. This role is likely played by department chairs in higher education. The leadership must acknowledge this new knowledge through rewards and allow it to change the vision of the organization.

Role of External Pressure

External pressure refers to the changing context within which organizations function. For higher education, one source of this external pressure is industry expectations of graduates. This can range from critical thinking skills to knowledge of the latest technology in the field (Brigham, 1996). For departments, this external pressure

could be from the institution's administration or external review committees (Kressel et al., 1999).

In environment-focused emergent change, external pressure is an important motivation for change. The organization must make changes to meet the external pressure to be competitive in the environment. This external pressure can motivate participation among organization members and formal leadership (Kressel et al., 1999).

Eckel and Kezar (2003) found that external pressure was necessary for institutions to encourage participants to think differently. For example, universities were more successful in creating transformative change if they frequently invited outside experts to analyze their universities. These experts questioned some of the beliefs and functions of the university in formal reports. The successful leaders took these reports, broadly distributed them, and engaged members in creating knowledge to address the issues.

In environment-focused emergent strategies, external pressure provides the motivation for change. The leadership encourages participants to create knowledge in order to meet the external pressures of the organization.

Summary and Critique of Environment-Focused Emergent Change

The defining quality of environment-focused emergent change is the facilitation of change instead of the management of change. Change must be facilitated because it is unpredictable and unmanageable. Eckel and Kezar (2003) describe facilitating change as a "mobile model." In this model, the different roles (participants, leaders, and external pressures) are interconnected. When one area experiences change, the entire process shifts, like a mobile over a child's crib. The elements of change happen at the same time

and are not a step-by-step process. This approach to change is relatively new to organizational change (e.g. Nonaka & Takeuchi, 1995; Senge, 1997) and few examples exist in higher education (Henderson et al., 2011).

Motivation for participants to engage in change activities comes from the discrepancies between the needs of the external environment and the products of the institution. The key process to change is the creation of knowledge through interaction between participants. This knowledge is shared with the leadership through individuals who act as “middle managers.” These middle managers in higher education are likely the department chairs. As this knowledge reaches the leadership, leadership redistributes it to participants to constantly reshape the guiding vision and to recognize short-term accomplishments. Figure 2.3 provides an overview of environment-focused emergent change features.

Environmental Emergent Change

External Pressure

- Provide need for change

Role of the Leaders

- Amplify good ideas
- Act as middle managers
- Open to criticism and change
- Articulate the vision

Roles of the Participants

- Interact to create knowledge
- Contribute to a flexible vision

Figure 2.3 Change strategies used in environment-focused emergent change

A limitation in this approach is the lack of empirically-based guidance for how to facilitate environment-focused emergent higher education change. It will be necessary for exploratory studies to address the first attempts at introducing environment-focused emergent change. In the following section, a strategy of environment-focused emergent change is presented to provide a framework for this type of change in higher education.

Complexity Leadership Theory

Complexity leadership theory, as developed by Uhl-Bien et al. (2007), is a change strategy from the category of environment-focused emergent change. Researchers

identify environment-focused emergent change as a promising new direction for change in higher education (e.g. Eckel & Kezar, 2003). Complexity leadership theory provides a framework for facilitating emergence of ideas within the hierarchy of an organization.

Two features of complexity leadership theory motivated its use as the representative of the emergent environment-focused category. First, complexity leadership theory includes the components of environment-focused emergent change within its framework (Figure 2.4). Environment-focused emergent change includes: roles of the participants (interacting in networks for creating knowledge, contributing to a flexible vision), roles of the leaders (amplifying good ideas, acting as middle managers, being open to criticism and change, articulating the flexible vision) and the role of external pressures (providing a need for change). Complexity leadership theory's three types of leadership (administrative, adaptive and enabling) and its external environment contain these features. Adaptive leadership includes the role of participants: knowledge creation in the interactions of the networks and vision modification due to knowledge creation. Enabling leadership includes the role of leaders (middle managers): fostering network interactions and amplifying good ideas. Administrative leadership includes the role of the leaders (formal hierarchy of the organization): open to criticisms and innovation. The external pressure of the environment in complexity leadership theory determines the type of innovations and change that organizations should adopt.

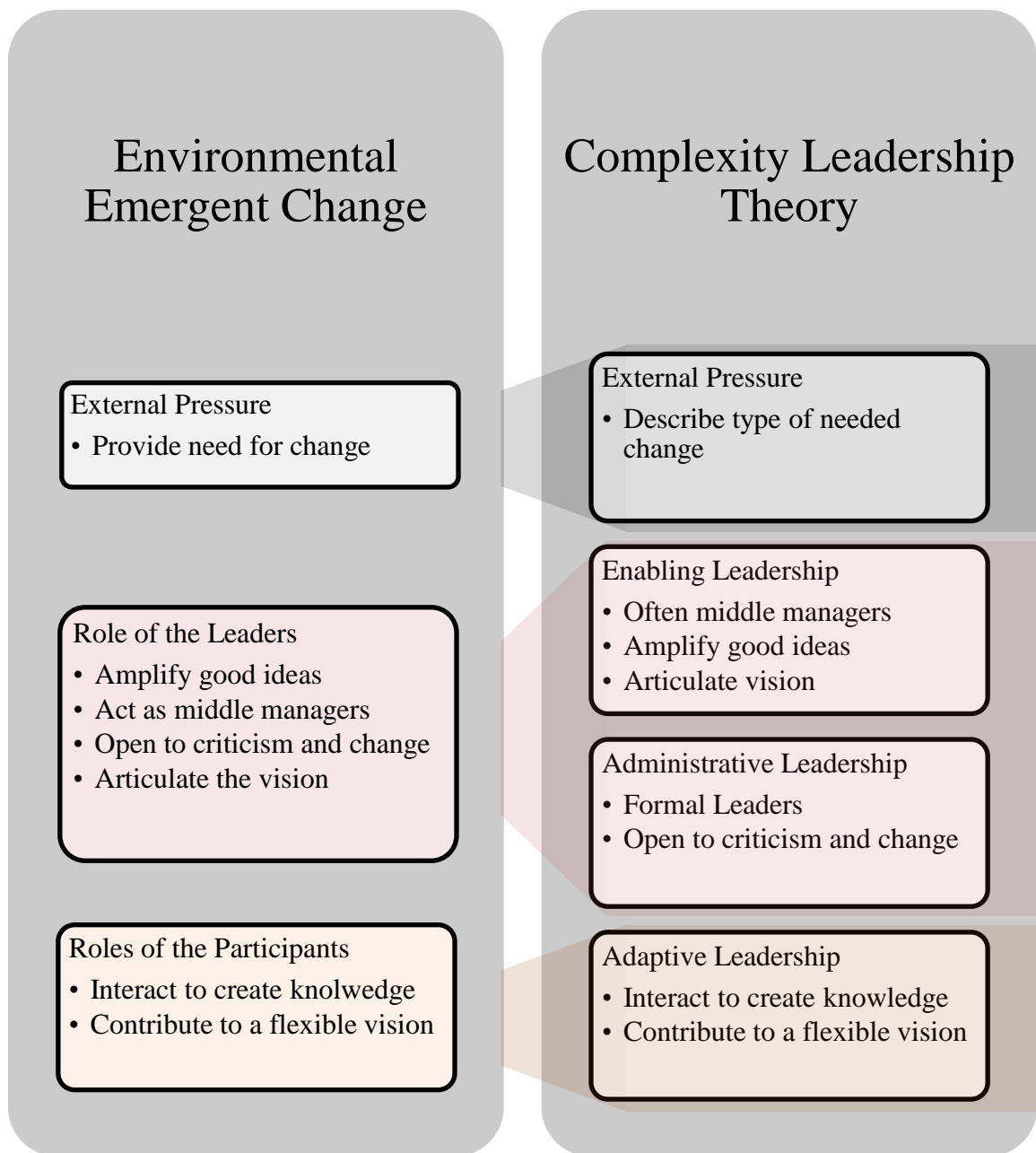


Figure 2.4 The components of emergent environment-focused change related to the aspects of complexity leadership theory

The opportunity to apply the latest theoretical development in organizational change to higher education is the second reason to choose complexity leadership theory

to represent environment-focused emergent change. Traditionally, it takes nearly a decade for higher education to adopt and benefit from advances in businesses and organizations (Birnbaum, 2000). Complexity leadership theory has promising theoretical backing, but is still relatively new to organizational change (Avolio et al., 2009). By investigating how to apply complexity leadership theory to change in higher education, education can apply recent advancements of organizational change.

Complexity leadership theory represents the promising category of environment-focused emergent change. It includes all of the aspects of environment-focused change and is a recent development in organizational change that has not been applied to higher education. The next section describes the features of complexity leadership theory. This is followed by lessons-learned from studies of complexity leadership theory in organizations.

Description of Complexity Leadership Theory (Uhl-Bien et al., 2007)

Complexity Leadership Theory (Uhl-Bien et al., 2007) aids organizations in efficiently evolving to meet the needs of their environment. In order to do this, the organization must create knowledge and innovations. According to complexity leadership theory, the potential to create useful knowledge is present in the organization (as opposed to needing to depend on external consultants to supply expert knowledge). The purpose of the leadership of an organization is to enable knowledge creation through fostering interactions between the organization members and to avoid stifling it through overbearing rules and regulations. Uhl-Bien et al. identified three types of leadership, administrative, enabling, and adaptive, that allow knowledge to be created to meet the

demands of the organization's environment. Leaders operate at all levels of the organization, high level (executives), middle level (middle managers) and low level (production). A single person may have more than one leadership role, depending on his or her actions in a specific situation. The next sections discuss the three kinds of leadership in complexity leadership theory and the interactions between them. Figure 2.5 provides a visualization of how these types of leadership interact.

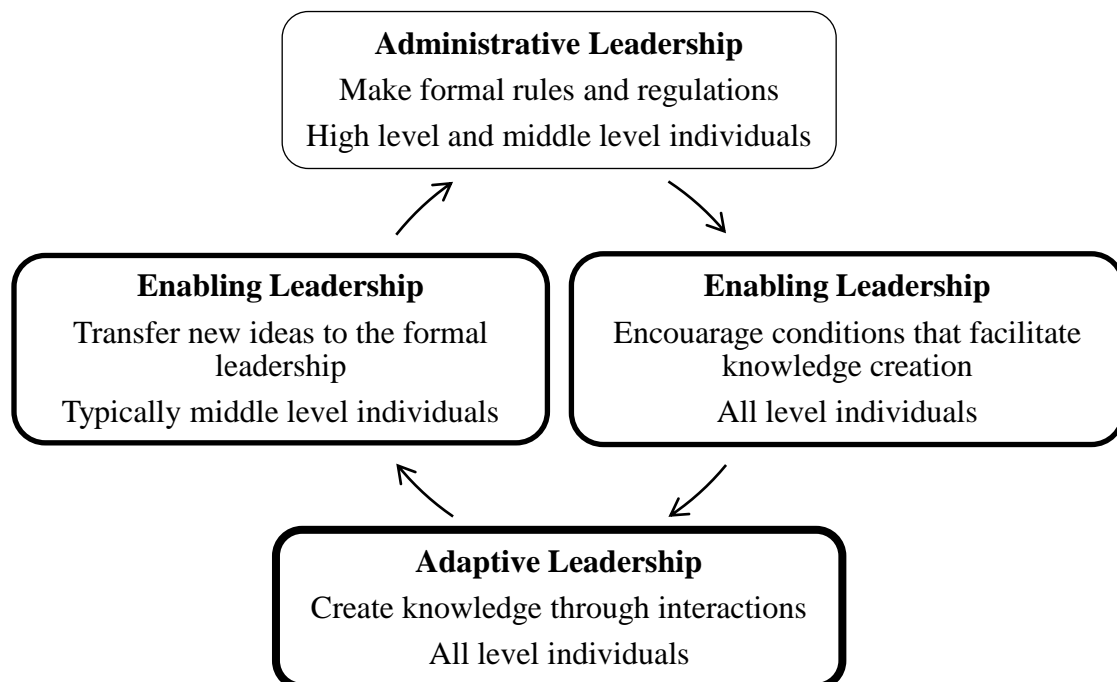


Figure 2.5 The roles and organizational locations of administrative, adaptive and enabling leadership (Schreiber & Carley, 2008; Uhl-Bien & Marion, 2009; Uhl-Bien et al., 2007)

Administrative leadership. Administrative leadership in complexity leadership theory refers to the formal leaders at the middle and top of the hierarchy of an organization. Administrative leaders are in charge of structuring tasks, planning for the future, building vision, and organizational strategy. It is important for individuals with

this type of leadership role to complete their tasks without stifling innovation in the organization. For example, a vision should articulate the future goals of the organization to help individuals develop vision-consistent new ideas but should be flexible to allow unexpected innovations. The administrative leadership must be open to criticism of current practices and opportunities for innovative change.

Adaptive leadership. Adaptive leadership consists of the creative actions taken by individuals or the organization due to the interactions between individuals. The networks of the low, middle, and high level individuals can contribute to adaptive leadership. Emergence of ideas occurs during interactions when there is interdependence and tension between individuals. When two individuals have conflicting needs or ideas but are dependent on each other for success, they must work together to develop a solution that fits both of their needs. The solution that they create emerges from their interaction. This process is the adaptive leadership of the organization. This solution is usually a new innovation or new knowledge.

In order for the interaction between two people with conflicting needs to result in emergence of new knowledge, each person must have expertise and creativity. Without expertise, the individuals will not be able to solve the problem, without creativity the individuals will not be able to develop new knowledge. Once a new solution is discovered, this new knowledge will have different levels of significance and impact. The significance refers to how useful the new knowledge is to the organization and the impact refers to how well the new knowledge is distributed to other areas of the organization. One way to increase the efficiency of adaptive leadership is to make individuals with

varying types of expertise dependent upon each other for success. The administrative leadership can promote the new knowledge in order to increase the impact of the change.

Interactions within the organization create adaptive leadership when the individuals have conflicting needs and must find a solution and the individuals have the necessary expertise and creativity to determine a solution. The solution will likely need to be an innovation or new knowledge. This new knowledge will have varying levels of significance and impact.

Enabling leadership. Enabling leadership facilitates change by (a) fostering the conditions that lead to adaptive leadership, (b) interfacing between administrative and adaptive leadership, and (c) disseminating innovations to the organization. As with adaptive leadership, enabling leadership can occur at any level of the organization. It is most likely to be an important part of middle level individuals' roles. Middle level individuals interact with the administrative leadership, which allows them to have some control over the creation of rules and regulations ((a) and (b)). They also interact with low level individuals of the organizations. This increases their awareness of innovations created by individuals across the lower levels of the organization. Middle level individuals can then communicate these innovations back to the high level individuals for distribution to the entire organization (c).

There are three conditions of adaptive leadership that enabling leaders can strengthen: interaction, interdependency and tension. (This is function (a) of enabling leaders.) First, enabling leaders promote interaction at the high, middle, and low levels of the organization. (Recall that all level of individuals can be enabling leaders, although it

is most likely to be the middle level's most important role.) Interaction between individuals of varying expertise is important for the creation of knowledge. For high and middle level individuals, fostering interaction may mean creating groups to complete tasks, or creating an open work-space for individuals to interact. High level enabling leaders might also increase their interactions with the organization's environment to discover the demands of the external stakeholders. Low level organization members can foster interaction (therefore becoming enabling leaders) by expanding their personal networks to individuals with expertise or by increasing their expertise by seeking out new knowledge. This increases the likelihood of creating significant new knowledge through their interactions. All levels of individuals can increase the number of connections that they have to foster knowledge creation. It is important for the middle level enabling leadership to protect activities that increase interaction from being stifled by the administrative leadership. This means encouraging administrative leadership to create groups for completing tasks, and maintaining opportunities for all level individuals to increase their own expertise. All levels of individuals can act as enabling leadership through fostering interaction, whether it is through creating connections or increasing his or her participation in interactions.

Second, enabling leaders can create the conditions of adaptive leadership by promoting interdependency throughout the organization. Interdependency encourages individuals to act on the knowledge developed through interactions. An individual finds motivation to solve conflicts, when his or her success depends on discovering a solution. It is important for enabling leadership not to interfere with these conflicts. It is the process of resolving conflicts that creates new knowledge. High level individuals can

foster interdependency by creating organizational rules that require coordination. Low level individuals can foster interdependency by coordinating efforts with their peers. Middle level individuals can protect interdependency by promoting organizational rules that require coordination.

Third, enabling leaders can foster tension within the interactions of the organization. Tension occurs when individuals are heterogeneous, interdependent, and have conflicting constraints. Interacting individuals will need to be creative in developing solutions to conflicts when they have varying expertise and also varying priorities in the outcome. High level individuals can foster tension by distributing resources and demanding group results. Low level individuals can enable tension by tolerating dissent and working together towards solutions. Middle level individuals create environments where it is expected that individuals will tolerate dissent and work together. Tension in interactions increases the significance of newly created knowledge.

Enabling leadership operates at the interface between adaptive and administrative leadership. (This is function (b) of enabling leaders.) Some of these functions have already been discussed as part of the function of fostering adaptive leadership. However, operating at the interface between adaptive and administrative leadership specifically refers to activities that avoid stifling rules and regulations and articulating the vision to the low levels of the organization. Protection of adaptive leadership usually comes from middle level or high level individuals. This enabling leadership provides resources and access to information to individuals. These leaders articulate the vision but do not restrain the creative process. Middle level individuals are important in protecting adaptive

leadership because they are aware of the needs of the high levels of the administrative leadership and the low levels of the adaptive leadership.

Finally, enabling leaders are the champions of innovations from the adaptive leadership to the systems of the organization. (This is function (c) of enabling leaders.) They identify useful innovations to modify the vision and to implement throughout the organization. Middle level individuals are likely to fill this role because they have connections to both the low level interactions and high level rules and regulations development. However, any individual who communicates innovations from their creation to the rule-making individuals of the organization acts as this type of enabling leader.

Enabling leadership facilitates adaptive leadership through fostering interaction, interdependency, and tension (a). High level individuals design organization features that encourage these features, or low level individuals increase their own level of interaction, interdependency and tension. Enabling leadership articulates the mission of the organization but does not allow it to be stifling to creativity (b). In addition, enabling leadership champions innovations to the structure of the organization as whole (c). Functions (b) and (c) are most likely to be fulfilled by middle level individuals who have connections to both the high and low levels of the organization.

This section has identified the features of administrative, adaptive and enabling leadership in complexity leadership theory. Administrative leadership makes the rules of the organization. Adaptive leadership creates the knowledge in the organization. Enabling leaders are the facilitators of change in the organization through fostering adaptive leadership, creating a pro-innovation environment and championing innovations. The

following section will include empirical evidence of enabling leadership roles in organizations. The goal of this section will be to summarize what is known about enabling leadership in organizations.

Applications of Complexity Leadership Theory

Enabling leadership facilitates change in the organization. Enabling leaders can be any person within the organization. For example, a person who is an administrative leader can also be an enabling leader if she creates conditions that facilitate change (possibly by creating work groups). Furthermore, a person who created knowledge through adaptive leadership can act as an enabling leader by communicating this knowledge to the administrative leadership (possibly by communicating innovations through open forums). Therefore, enabling leadership can overlap with the other two types of leadership roles and encompasses all individuals who work to facilitate change in the organization. There are three activities used to identify these enabling leaders: fostering adaptive leadership, avoiding stifling regulations and articulating the vision, and promoting innovations. Figure 2.6 is an adaptation of Figure 2.5 that highlights these three features of enabling leadership.

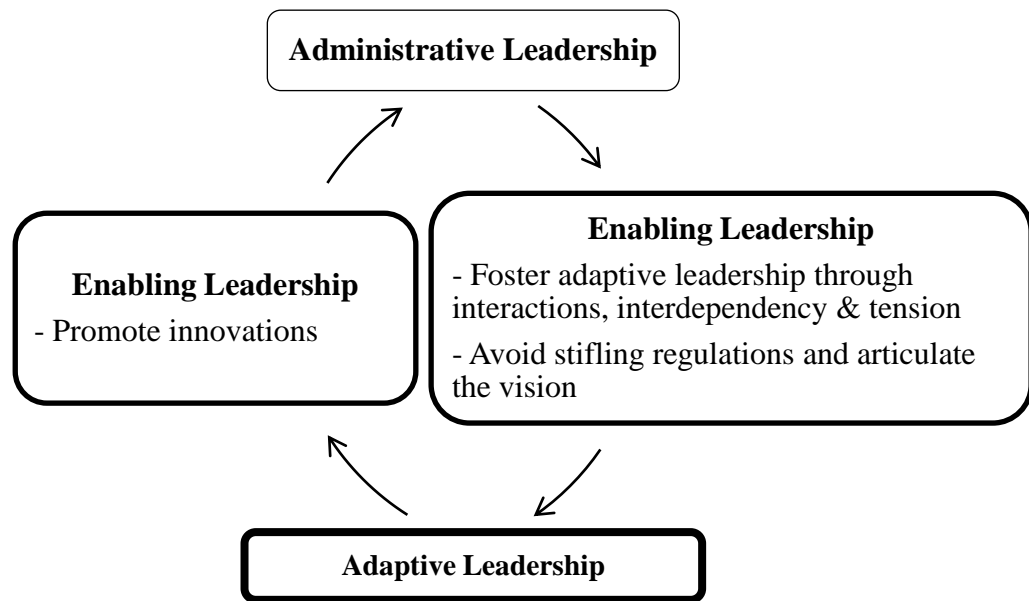


Figure 2.6 The roles of enabling leadership in complexity leadership theory

This section includes the lessons-learned from applications of complexity leadership theory to organizational change. The three categories of enabling leadership (fostering adaptive leadership, avoiding stifling regulations and articulating the vision, and promoting innovations) organize this discussion. A limitation of a relatively new approach to emergent change is the availability of empirical evidence. Although much has been written on the theoretical basis of complexity leadership theory, it is relatively new to empirical studies (Avolio et al., 2009). This section will identify what has been learned from these early applications of complexity leadership theory to organization change.

Fostering adaptive leadership. Fostering adaptive leadership includes encouraging interaction, interdependency, and tension. Encouraging interactions could be accomplished by creating work groups. Interdependency is increased when collaboration in work groups is necessary for success. (Individuals are not able to independently fulfill their role in the group.) Finally, tension might be increased by tolerating dissent and encouraging cooperation in these groups. The following studies identify how to develop these work groups and to increase their productivity by fostering interdependency and tension.

The first step of creating work groups is deciding whom to involve in each group. A study by Weibler and Rohn-Endres (2010) investigated individuals involved in work groups to determine the dynamics of productive groups. The authors found that these interactions needed to be built on trusting relationships to be successful. The smaller the group and the more stable it was, the more trusting these relationships seemed to be. However, Plowman et al. (2007) argue that in order for innovations to develop a group needs to be de-stabilized and in a state that is “far-from equilibrium.” They argue this state of unease makes the importance of adaptive leadership increase. These two studies provide advice on how to create work groups to foster interaction, interdependency and tension that leads to adaptive leadership. Weibler and Rohn-Endres (2010) argue for trusting relationship that develop from stability, while Plowman et al. (2007) suggest that some instability is necessary to increase tension and interdependency. Therefore, enabling leadership should develop a balance between creating a safe environment for individuals to share their feelings and an unstable environment that provides motivation

for innovation. Middle level individuals can help discover this balance by moderating the conditions of the group and reporting it to the group-organizing individuals.

Second, enabling leaders may also wish to create interdependencies through work group creation. Uhl-Bien et al. (2007) suggest this could be accomplished by creating rules that require individuals to collaborate in order to complete activities. It is useful to know which individuals in an organization are independent actors to choose who to involve in new collaborations. Hanson and Ford (2010) investigated how complexity leadership theory applied to the success of laboratory subunits of a hospital. (Examples of subunits were laboratory groups, the morgue, and transcriptions. In this study, subunits are the units of analysis instead of individuals.) In their study, the authors identified the level of interdependency between subunits by analyzing the unit's cognitive demand. Cognitive demand is a network analysis tool used to determine how much collaboration is necessary to complete a task (Carley & Ren, 2001). The authors created a network representation of the hospital interactions to illustrate the necessary connections made during the day-to-day tasks of each subunit. The authors found that the subunit of transcription had low cognitive demand. This means that the daily responsibilities of the transcription unit did not require interaction with the hospital at-large. Therefore, the interdependency of this subunit was low. The change agents would need to target this subunit in future work groups in order to foster enabling leadership. This new group would benefit from the transcription subunit's expertise. A change agent can use this study to inform the forming of subgroups to encourage interdependency of the organization. First, an analysis of cognitive demand identifies independent individuals. Second, the change agent assigns tasks to these individuals that require group

collaboration. This work group increases the level of interdependency of the organization.

Third, change agents foster adaptive leadership by building tension within and across work groups. Enabling leaders create tension within work groups by tolerating dissenting opinions and encouraging individuals to work towards solutions of conflicting interests (Uhl-Bien et al., 2007). An enabling leader tolerates dissent by not requiring agreement in group meetings (Weibler & Rohn-Endres, 2010). The enabling leader acknowledges and encourages alternate opinions during meetings and helps the group search for solutions to resolve conflicting interests. In work groups, this is an important function of the group leader. This is likely to be middle level individuals. Middle level individuals can foster tension by creating a group culture that tolerates and encourages dissenting opinions. Change agents can also foster tension across work groups by disrupting normal patterns of operation. For example, Plowman et al. (2007) studied transformational change in an urban church. They found that complexity leadership theory explained how the church was able to change from a low-attendance failing church to a thriving mission to the homeless community. In their study, the leaders of the church fostered tension by disrupting patterns of behavior. For example, the leaders held forums to discuss and unveil hidden conflicts among subgroups of the church. This led to new knowledge that was used to modify the church's vision and change the church's activities. Although not a traditional organization, the forums held by the leaders of the church brought together different "work" groups of the congregation. The leaders encouraged the groups to communicate through the open forum and to develop knowledge that could direct the future of the church. This tension across groups helped

the organization as a whole choose a vision to guide their future. Tension may be increased by middle managers as leaders of localized work groups, or could be organization-wide when leaders gather many work groups to discuss tensions between them. It is important to have this tension in order to lead to adaptive leadership that guides the future directions of the group (or the organization).

Fostering adaptive leadership requires creating interactions, interdependency and tension. Work groups create environments for adaptive leadership to occur. Work groups should have enough stability to build trusting relationships but be diverse enough to allow for dissenting opinions. The level of interdependency is the cognitive demand an individual needs to complete daily tasks. If this is too low, an enabling leader could increase it by involving the person in a new work group. Finally, work groups or organization-wide meetings create tension when dissent is allowed and patterns are disrupted. Enabling leadership increases these conditions to foster adaptive leadership (discussions that will lead to new knowledge).

This area of research provides insight into what has been successful in facilitating adaptive leadership. For example, it seems that disrupting existing patterns in order to reveal dissent is beneficial in leading to solutions of conflicts. However, it is unclear how much diversity in a work group allows for this disruption but also develops trusting relationship enough to discuss dissent. Further articulating and expanding these findings is an area of future research in organizations and also will need to be addressed in higher education.

Avoiding stifling regulations and articulating the vision. The enabling leadership function of avoiding stifling regulations and articulating the vision guides the solution development of adaptive leadership. Avoiding stifling regulations allows individuals to interact and develop solutions to conflicts. Articulating the vision provides a guide for determining appropriate solutions to conflict.

Overly formal group structures stifle productivity. Informal structures help generate emergent outcomes because individuals become more involved in meeting proceedings (Weibler & Rohn-Endres, 2010). Enabling leaders guide informal structured work groups with “simple rules” instead of formal roles (Plowman et al., 2007). Simple rules are guidelines for actions. They are broad statements that coordinate individuals’ behavior without specifying exactly how to follow them. In Plowman et al. (2007), the simple rule the church followed in its transformation was “What would Jesus do?” If an innovation fit into this simple rule, then it was an acceptable activity or direction for the church to consider. Simple rules provide guidance to work groups without restricting creativity through overly formal structures.

Unlike the relatively stable simple rules that guide informal structures, the vision is flexible and changes as knowledge emerges from the organization. Enabling leaders articulate the vision as it changes to give flexible guidance to activities of the organization. Plowman et al. (2007) found that leaders articulated the mission of the church by identifying individuals or ideas that embodied the vision. These innovations or people were “tags” or examples of what change fit the direction of the church. This articulation helped individuals in the church understand how the vision could be applied

to events or behaviors. As the vision changed, the church identified new “tags” to represent the new vision, or the “tags” changed their behavior to meet the new vision.

Avoiding restrictive regulations and articulating the vision give guidance to the direction of adaptive leadership. Simple rules provide stable guidance for actions, while the vision changes as new knowledge emerges. A future area of research in this area is providing guidelines of what level of administrative leadership is too restrictive and stifles creativity and what level is too unguided for progress.

Promoting innovations. Finally, enabling leadership works to promote innovations from their creation in adaptive leadership to organization-wide implementation. The promotion of innovations is necessary for modifying the vision. This modification of the vision reminds the organization that the future state is unknown and the innovations created in the present can improve it (Plowman et al., 2007).

This process includes identification of useful innovations through feedback from members of the organization and development of new language to discuss the new innovations. Enabling leaders identify new innovations to distribute to the organization through interaction with adaptive leadership (Weibler & Rohn-Endres, 2010). Once new innovations are identified, Plowman et al. (2007) suggest that enabling leaders should act as sensemakers. The enabling leadership must provide the language needed to discuss the innovation. This language helps the administrative leadership understand why the new innovation fits the simple rules of the organization. When the new innovation fits the vision (in addition to the simple rules), administrative leadership expands it to the organization through formal rules. When the innovation is slightly different than the

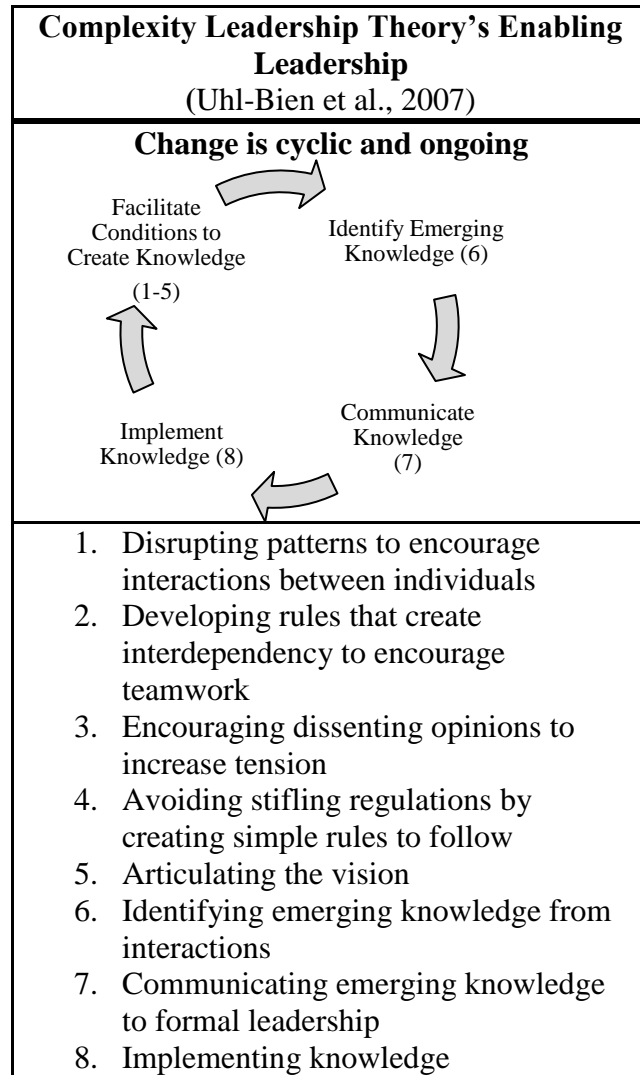
vision, it may be necessary to modify the vision to include the innovation and adjust the future direction of the organization.

This function of enabling leadership promotes emergent innovations to the organization. This requires enabling leaders to identify useful innovations, amplify them to organization-wide implementation, and provide new language to discuss how these innovations fit the simple rules and might modify the vision. Areas of future research in this topic include how to identify potentially significant innovations from the emergent changes within the organization.

Summary of Complexity Leadership Theory

Complexity leadership theory has three types of leadership: administrative, adaptive, and enabling. Any time a person contributes to change in the organization, he or she is an enabling leader. This means that an administrative leader that is identifying and communicating a new idea is also acting as an enabling leader. A person who increases their knowledge to improve the learning that comes from interactions of adaptive leadership is an enabling leader. Enabling leaders have three functions: fostering adaptive leadership, avoiding stifling regulations and articulating the vision, and promoting innovations (summarized in Table 2.4). These roles can be played by individuals in an area of the organization, but middle level individuals may be the most important for achieving enabling leadership.

Table 2.4 Summary of complexity leadership theory's enabling leader activities



Work groups are an important feature of complexity leadership theory applications. Work groups should be informal and guided by simple rules and the vision. They should be stable enough to create trusting relationships but also have some instability to encourage emergent ideas. When groups meet, enabling leaders increase tension by exploring dissenting opinions and searching for solutions. Enabling leaders guide direction of the work group through articulation of the vision. When groups create

solutions, enabling leaders promote these ideas to the administrative leadership. This promotion requires the development of new language to show the connection of innovations to the simple rules. These innovations may require a modification of the vision, which then will need to be re-articulated to the group to show how their efforts are changing the future of the organization.

Complexity leadership theory has a strong theoretical background in the literature, but has only recently been applied to empirical studies (Avolio et al., 2009). These first applications provide evidence that complexity leadership theory is useful in understanding organizational change in a variety of settings (e.g. Plowman et al., 2007). The limitations to these studies are due to their exploratory nature. They consist mostly of description.

Theoretical Frameworks: Two Change Strategies

This literature review has identified two distinct change strategies that have the potential to be useful in higher education change. The eight-stage leadership process has demonstrated effectiveness for creating environment-focused prescribed change. Complexity leadership theory is a promising method for facilitating environment-focused emergent change. Although these are different approaches to change, it is likely not necessary to choose just one approach to guide a particular change initiative. For example, in a study of departments that demonstrated excellence in teaching, Gibbs et al. (2009) found 7 of 19 departments had undergone emergent change, 7 had undergone planned change, and 5 had undergone a mixture of planned and emergent change. This

indicates that both prescribed and emergent change may be successful in higher education. It also suggests that some aspects of both prescribed and emergent change may exist within a single change initiative.

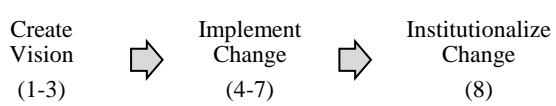
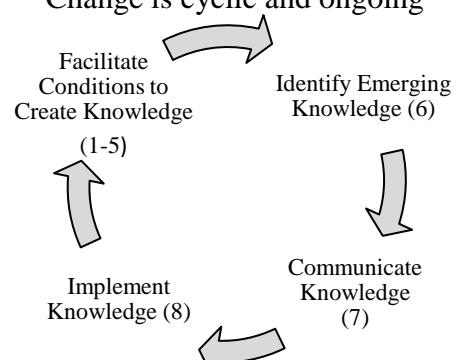
If both approaches can be successful, then instead of choosing just one approach, Burnes (1996) suggests that each organization should determine what type of change works best for its preferences and contextual features. Does the organization prefer to be managed and have central leaders? If so, it will respond well to the top-down mandates of prescribed change. Does the managerial staff prefer to promote new ideas over rewarding compliance? If so, then emergent change's tendency to promote new knowledge is better suited for the environment. Change agents will need to know how to choose strategies (or approaches within strategies) that match the contexts of their specific environments within higher education. In order to understand these options, it must first be determined how these two change strategies are represented in higher education and how each strategy frames problems and solutions to guide change agents in making the best choices from each type of change strategy. The next section articulates the similarities and differences between the two strategies to identify the characteristics that are associated with each theory.

Comparison of the Eight-Stage Leadership Process and Complexity Leadership Theory

To determine the characteristics associated with each strategy, first, a summary of the strategies is needed to understand their essential qualities. The eight-stage leadership process is a step-by-step plan for managing change. It requires a powerful guiding coalition to develop a vision and monitor the implementation of changes (Kotter, 1996).

The process is complete when the organization institutionalizes the change. The first column in Table 2.5 lists the main components of the eight-stage leadership process. Instead of developing a vision and then devising a plan to accomplish that vision, complexity leadership theory creates conditions conducive to productive emergent change: interactions, interdependency, and tension between individuals (Uhl-Bien et al., 2007). An enabling leader is a person who promotes these conditions. Enabling leaders can be any member of the organization (e.g. high level – deans/provosts, middle level – department chairs, low level – faculty members). The second column in Table 2.5 lists the main components of enabling leadership. Enabling leadership fosters interactions, interdependency and tension, (items 1-3), avoids stifling of these conditions and articulates the vision (items 4-5), and promotes innovations to the organization as a whole (items 6-8) (Uhl-Bien et al., 2007).

Table 2.5 The main components of the eight-stage leadership process and complexity leadership theory

Eight-Stage Leadership Process (Kotter, 1996)	Complexity Leadership Theory's Enabling Leadership (Uhl-Bien et al., 2007)
<p>Change is episodic, with a clear beginning and end</p>  <pre> graph LR A[Create Vision (1-3)] --> B[Implement Change (4-7)] B --> C[Institutionalize Change (8)] </pre>	<p>Change is cyclic and ongoing</p>  <pre> graph TD A[Facilitate Conditions to Create Knowledge (1-5)] --> B[Identify Emerging Knowledge (6)] B --> C[Communicate Knowledge (7)] C --> D[Implement Knowledge (8)] D --> A </pre>
<ol style="list-style-type: none"> 1. Establishing a sense of urgency 2. Creating the guiding coalition 3. Developing a vision and strategy 4. Communicating the change vision 5. Empowering broad-based action 6. Generating short-term wins 7. Consolidating gains and producing still more change 8. Anchoring new approaches in the culture 	<ol style="list-style-type: none"> 1. Disrupting patterns to encourage interactions between individuals 2. Developing rules that create interdependency to encourage teamwork 3. Encouraging dissenting opinions to increase tension 4. Avoiding stifling regulations by creating simple rules to follow 5. Articulating the vision 6. Identifying emerging knowledge from interactions 7. Communicating emerging knowledge to formal leadership 8. Implementing knowledge

These two strategies have different assumptions about how change works. The eight-stage leadership process assumes change can be planned and controlled, while complexity leadership theory assumes change can only be facilitated. However, each strategy uses the same language to describe key characteristics. For example, both models have a vision and leaders. These models can be differentiated by examining the

differences in the attributes of the key characteristics. Table 2.6 provides a summary of these key characteristics and the attributes associated with them in each model. The stage and item numbers in Table 2.6 refer back to the summary in Table 2.5. The characteristics described in Table 2.6 are discussed in more detail in the paragraphs that follow.

Table 2.6 Attributes of key characteristics in each change model

Key Characteristics	Eight-Stage Leadership Process		Complexity Leadership Theory	
	Attribute	Stage	Attribute	Item
Vision (New Ideas): Change involves the use of new ideas in the organization.				
Who promotes	The guiding coalition	1-4	Enabling leadership at the high or middle level	4-8
Who creates	Developed by or in consultation with experts (often outside sources).		Emerges via knowledge creation due to interaction between individuals	
When selected	Chosen within the first three steps of the change initiative		Develops throughout the change initiative	
Knowledge: Expertise and knowledge are required for creating change.				
What Kind	In areas of expected outcomes of change	2	In diverse areas related to the organization	1-4
Who	Members of the guiding coalition		In interactions (high, middle or low level)	
When	Present from the beginning		Any time throughout change	6
Decisions: Decisions must be made during the change process.				
Who	Guiding coalition is the decision maker	1-3	Often middle level individuals	6
When	Most decisions made in the beginning		Decisions made throughout the change initiative	
Employee Roles: Employees of the organization must be involved in change.				

Table 2.6 --Continued

High Level Individuals (e.g., Deans, Provosts)	Provide Vision	1-3	Primary role: Formalize good ideas	4,8
Middle Level Individuals (e.g., Department Chairs)	Communicate the vision between guiding coalition and workers	4-7	Primary role: Identify new knowledge to communicate to the formal leadership	7
Low Level Individuals (e.g., Faculty, Staff)	Implement vision	6-8	Contribute new ideas based on unique knowledge, skills or perspectives	1-3
Building Momentum: Successful change involves aligning employees around key ideas.				
Who promotes	Planned by the guiding coalitions	6	Identified by the enabling leadership	5-8
Role in change process	Used to sustain motivation in long-term change		Used to articulate the vision	
Change Process: Change can be seen as either discrete or continuous.				
End of Change	When new structures have been institutionalized	8	Never-ending. Equilibrium is avoided	NA

Eight features are part of both the eight-stage leadership process and complexity leadership theory. The attributes of the first six features (vision, expertise, decisions, and roles of the high/middle/low level individuals) have two differences: (a) *who* enacts these features (high, medium, or low level individuals), and (b) *when* these features should occur. The final two features (building momentum and the end of change) focus on how the attributes contribute to the process of change. For the eight-stage leadership process, momentum is built through short-term wins to convince low level individuals to

implement change. Institutionalized change marks the end of the process. For complexity leadership theory, momentum is built to modify the vision to create continuous change.

In the eight-stage leadership process vision, decisions, and expertise are present in the beginning of the process and the guiding coalition (the high level individuals) creates or manages them. The middle level individuals tell the low level individuals what change to implement. In the eight-stage process, the high level individuals are the most important and most decisions are made in the beginning of the change.

In complexity leadership theory, expertise is present throughout the organization and employees with different job responsibilities have different knowledge and perspectives. Combining the expertise of these diverse individuals leads to new knowledge. The middle-level individuals then decide which new knowledge represents potential improvements to the organization. This process happens throughout the change process to modify the vision. In complexity leadership theory, the low level and middle level individuals play a larger role in determining the change that occurs and change happens throughout the process. In complexity leadership theory, most features happen throughout the change process and the low level and middle level individuals are very important in creating change.

This differentiation provides a method for distinguishing between the two theories. First, it identified key characteristics of change that are important for both strategies. It will be important for change agents to be aware of the need to incorporate these characteristics. Second, it articulated how each strategy addresses these key characteristics of change with different approaches.

Conclusion

This literature review identified two representative change strategies within the category of environment-focused change. The two strategies are distinct because they assume either a prescribed or emergent approach to change. However, each strategy addresses the same key characteristics. It is not necessary to choose a single strategy to address the needs of change in higher education. Instead, it is the role of the change agents to identify which strategy is appropriate for their context of change. In order to make informed decisions between each strategy (and approaches within a strategy), a change agent needs to understand how each strategy is represented within the context of higher education. Furthermore, change agents need to know how to use these strategies to address problems in the change process. The following chapter describes the methods of this study that were chosen to address these change agent needs.

CHAPTER III

METHODS

Methodology

Case study methodology was used to understand the relationship between change in higher education and the two specific change strategies discussed in Chapter II. This section provides theoretical support for choosing a case study analysis to answer the research questions and outlines the process used to collect and analyze data. First, the appropriateness of a case study analysis is discussed. Next, the unit of analysis is discussed with respect to the context of change, change in higher education literature, and the research questions. Finally, the data collection and analysis methods are outlined.

Case Study Analysis

The guiding questions of this research ask how change in higher education is described by the two environment-focused change strategies. As discussed in the literature review, more in-depth understanding of each of these change strategies is needed in order to inform future change initiatives. Therefore, the approach taken to answer the research questions is a detailed analysis of a single change initiative. A case study analysis approach provides this detail through primarily qualitative methods (Yin, 2009). This institution-based change initiative (discussed in more detail later) is large and

complex enough that it can be conceptualized as five more-or-less independent departments within the larger initiative. Each department, though, is connected within the same local context and general parameters of the change initiative.

This case study is unique because it used both prescribed and emergent strategies together. The change strategies are articulated by comparing the two strategies (theoretically) and providing evidence of how the strategies describe the change that took place in academic departments. These descriptions are used to frame challenges in the change process and potential solutions.

Context

This section provides an outline of the change initiative design and articulates the rationale for choosing the department as the unit of analysis. Figure 3.1 shows an overview of the different entities of the case study. This includes: individuals, courses, departments, a teaching and learning center, and change initiative participation. The smallest analysis level is the individual. Each individual is situated in a campus entity (department or center). These individuals may also be involved in change initiative activities (either course changes within the department or faculty learning communities (FLCs) outside of the department). The following section provides details about each of these associations.

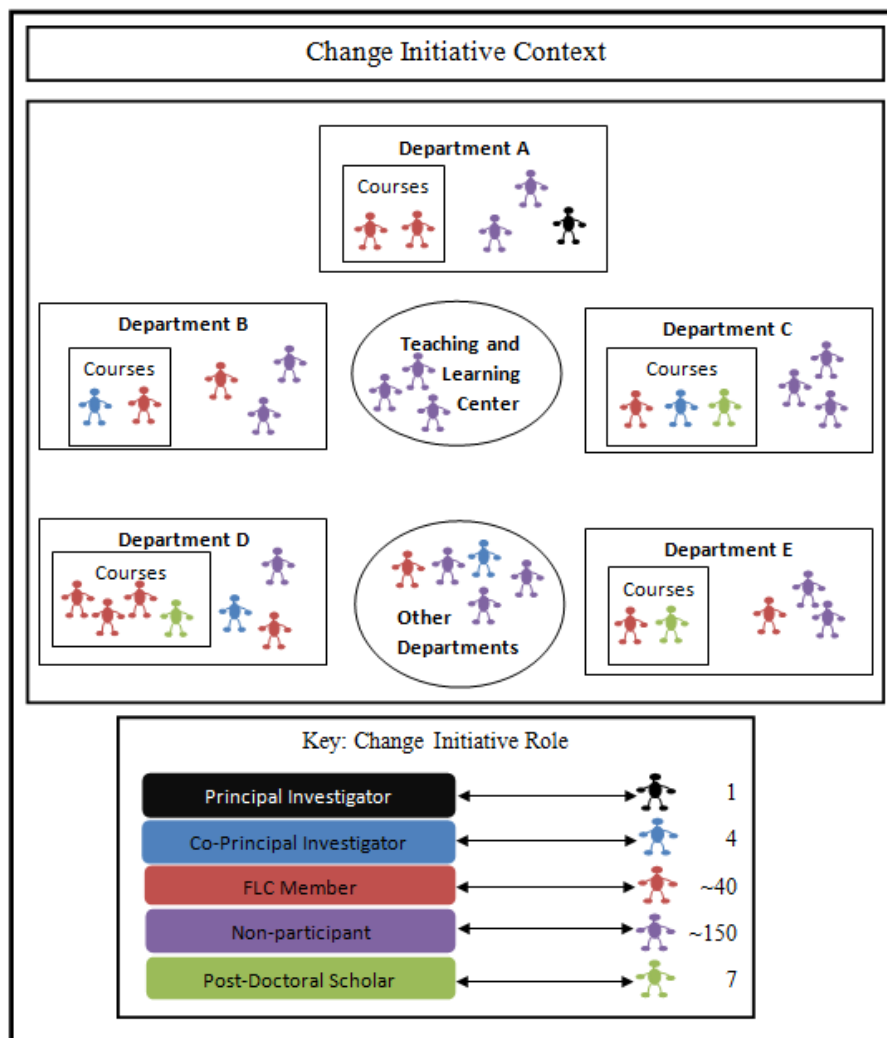


Figure 3.1 Change initiative context

Change Initiative Design

This case study is the analysis of a single change initiative. The change initiative took place within the College of Arts and Sciences at a large research university. Five of the six natural and life science departments were directly involved in the initiative, which received significant external funding (~\$1.6M). The change initiative's goal was to improve the science experiences of freshman and sophomore undergraduate students. The

leadership of the initiative included a lead principal investigator (PI) and four co-principal investigators (co-PIs) from four of the five departments. One of the co-PIs was closely related with department B (although not through formal appointment).

Throughout the four-year initiative, five post-doctoral scholars worked, at different times, with three of the five departments to help facilitate change. Figure 3.1 provides an overview of the types of participation of each department, and the results section will provide more detail about participation of each department.

The approach to change taken by the PIs of the change initiative was to facilitate emergent change. Rather than require compliance to a set of pre-determined changes, the initiative partnered with members of the department to develop new ideas that fit the overarching goal of the change initiative. (Although the intention of the initiative was environment-focused emergent change, the analysis will be used to determine how each change strategy is represented in the change that occurred.)

Retreat events and faculty learning communities (FLCs) facilitated change. Retreats occurred at the end of the academic year to give faculty a chance to share what they had learned and to rally support for the following year's activities. Also, each year, three to four faculty learning communities (FLCs) facilitated this interaction. Learning communities met about twice a month during the school year. Each community had a different focus. The FLCs topics included: laboratory changes (Laboratory FLC which became the Research FLC), large-lecture changes (Introductory Lecture FLC), upper level courses (Upper Level FLC) or discipline-specific changes (Department E & D, Department E, and Department D FLCs). Each community had between six and fifteen members. In the final two years, a Graduate Teaching Assistant learning community

(GTALC) was also included. Figure 3.2 provides an overview of FLC topics in each year. For ease of reference, the Laboratory (later Research) FLC will be referred to as the Laboratory FLC.

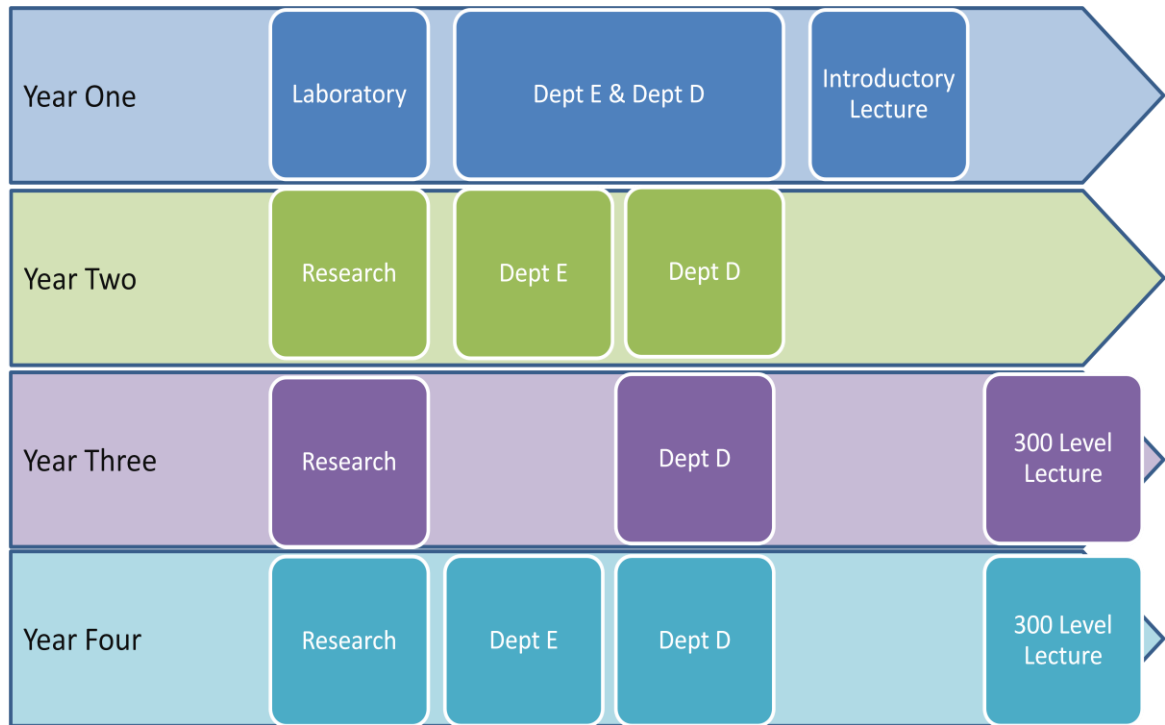


Figure 3.2 Faculty Learning Communities (FLCs) during the four years of the change initiative

In summary, the change initiative had one PI and four co-PIs. Four of the five science departments were represented in the leadership. This leadership facilitated emergent change through faculty and graduate teaching assistant learning communities (FLCs and GTALC). The FLCs were facilitated by two faculty members. The GTALC was facilitated by the post-doctoral scholars. Learning communities' membership included instructors, graduate students, and co-PIs. The PI made occasional visits to

learning communities and met with facilitators throughout the process. A total of five post-doctoral scholars were involved at some point in the project period and contributed to change in three of the departments.

Institutional Structure

In each department of Figure 3.1, some members are listed as non-participants in the change initiative. A “non-participant” is defined as a member of the department who did not participate in any of the formal activities supported by the change initiative, such as FLCs, retreats, conferences, or other similar activities. These individuals were still contacted to participate in the case study (some accepted while others did not).

Individuals not involved in the initiative were included to gain insight from all members of each department. Furthermore, the institution had a center for teaching and learning to assist department members with their teaching assignments (technology training, resources, etc.). Although individuals in this center were not directly involved in the change initiative, they were seen as valuable data sources to triangulate information provided by department members. The center had similar goals as the initiative, and therefore may have been a resource for members involved in the change initiative.

Unit of Analysis

The department was chosen as the unit of analysis of the case study. This choice was made in order to align the design of the study with the context of the research, the literature on change in higher education, and the guiding research questions. This alignment is recommended by Yin (2009).

For alignment with the context of the research, the department is an appropriate, logical choice because departments mostly act independently of one another with respect to course and curriculum changes. In the context of this study, change that is adopted by the department does not need to be accepted by other departments. Therefore, departments can be considered as separate units within the university.

Furthermore, researchers argue that the academic department is the most productive unit of change because a department is responsible for curriculum and tenure decisions, it can act independently, and instructors often share their knowledge and values within the department at committee or faculty meetings (e.g. Edwards, 1999; Gibbs et al., 2008; Wieman et al., 2010). The department as the unit of analysis aligns the research design with the unit that is expected to be the most productive for change according to the literature.

Finally, the choice of the department is appropriate for answering the guiding research questions. The research questions are based on the literature of change in higher education. To contribute to the development of environment-focused change initiatives, the guiding research questions ask how structural change strategies inform this process in academic departments. The department should be the unit analysis because it has structural features that could be impacted by change and the research questions ask specifically how structural change occurs within academic departments.

In summary, the department is the unit of analysis that aligns the design of the research with the context, literature, and guiding research questions. Because there are multiple units of analysis within a single case study, this is an embedded, single-case design (Yin, 2009).

Limitations and Role of the Researcher

As with any research project, there are some limitations associated with the proposed design. First, data collection will require responses from STEM instructors – both those involved and not involved in the change initiative. Response rates are likely to be higher for individuals who have been involved in the change initiative. The involved individuals will also likely be interested in representing the change as successful. It will be important to use triangulation from data sources that are less involved in the change. For example, if a faculty member is discussing changes in his classroom, the viewpoints of the chair of the department or the leadership of the change initiative can be used to confirm the claims made by the faculty member in charge of the change. Further discussion of triangulation follows in the analysis section.

Second, in the literature review, a concern was that many studies on single in-depth change initiatives were completed by the change agents. This may have lead to researcher bias. This study is not completed by the change agents. This will reduce this type of bias, but also means that the researcher may be considered as an outsider by the participants. This could lead to participants withholding information or feeling uncomfortable sharing struggles. To address this challenge, participants were reminded of the goal of the study (to understand the change process) at the beginning of each interview. Participants were also told how important it was to share both successes and trials. Finally, triangulation is again important to use multiple sources to understand how change took place.

Data Collection

The department level was chosen as the unit of analysis within the change initiative. Multiple data sources were used to converge on a single set of findings for each unit of analysis (Yin, 2009). This allows for triangulation of ideas from multiple sources (acting as a test of validity) (Stake, 1995; Yin, 2009). Data collection began during the first semester of the change initiative and continued into the fourth year. The WMU Human Subjects Institutional Review Board (HSIRB) determined that review of this project was not required. The HSIRB at the change initiative's institution only required notification of this decision for this project to take place. (The letters from both review boards are located in Appendix A). The data sources included: leadership artifacts (meeting minutes, year-end reports, presentations), Approaches to Teaching Inventory (Trigwell & Prosser, 2004) administered to members of the faculty learning communities, semi-structured interviews with department members (both involved and uninvolved with the change initiative including: graduate students, post-doctoral scholars, laboratory coordinators, lecturers, and professors), registrar-collected faculty characteristics (gender, title, etc), co-teaching assignments, and social networks. Data source details are shown in Table 3.1 and collection timeline in Figure 3.3. In particular, the table includes the collection date and whether it was collected from the change initiative leadership, participants in the FLCs, or all members of the relevant departments.

Table 3.1 Data sources and collection dates

Source(s)	Participants	Year(s)
Interviews	Leadership, All Department Members	1, 2, 4
Leadership Artifacts	Leadership	1, 2, 3
Social Networks Survey Comments	All Department Members	2,3
Teaching and Learning Survey	All Department Members	2
Social Networks	All Department Members	2, 3
Approaches to Teaching Inventories	FLCs	1,3
Faculty Characteristics	All Department Members	2
Co-Teaching Assignments	All Department Members	1, 2, 3

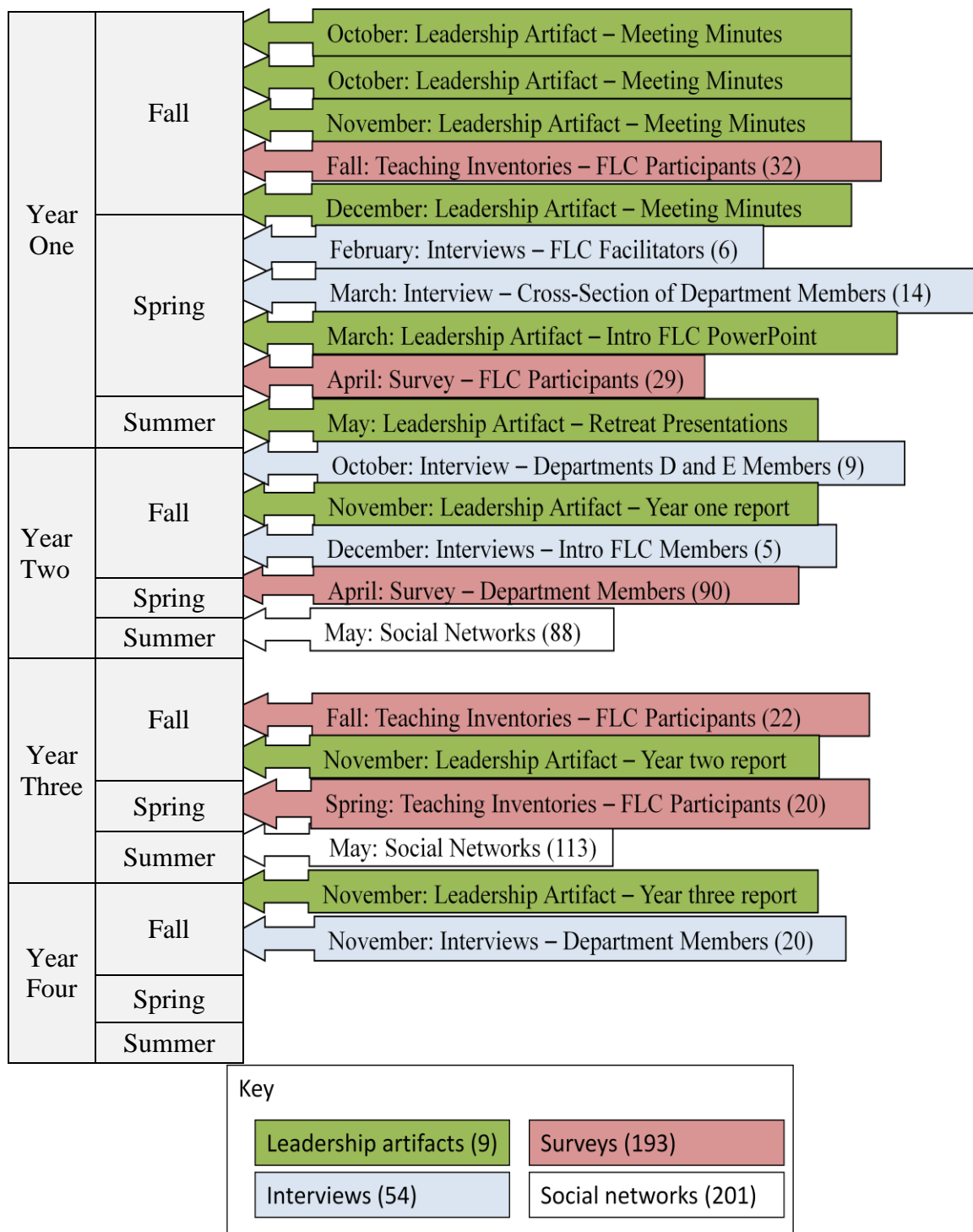


Figure 3.3 Data collection timeline

To provide the information needed to answer the research questions, the primary data types were leadership artifacts, interviews, and comments collected on the social network surveys. Demographic data, social networks and teaching assignments were also collected to provide triangulation and refine the convergence of the qualitative data (Yin, 2009). Although these data sources may have been analyzed quantitatively, they were used qualitatively to inform the primary data. The process for analyzing the multiple data sources will follow in the Analysis section. The remainder of this section addresses the instruments used to collect data.

Leadership Artifacts

Leadership artifacts include meeting agendas, year-end retreat agendas and presentations, and year-end formal reports to the funding agency. These documents were primarily created by the leadership of the change initiative. Usually the PI was the author; however, often the documents were informed by the co-PIs, post-doctoral scholars, and other change initiative participants. This data was provided in text, PowerPoint slides, or audio recordings. Meeting notes and agendas were the focus of early data collection to gain an understanding of the design of the change initiative. Year-end reports collected throughout the initiative provided an overview of the progress of the change initiative.

Interviews

Interviews happened throughout the change initiative. Sometimes interview participants were targeted to evaluate specific aspects of the change initiative. For example, in year 2, the Introductory FLC had a difficult time finding participants. Phone

interviews were conducted with individuals who had declined an invitation to participate in the FLC. This provided insight into why these individuals chose not to participate, as well as gathered suggestions for FLC activities that would better fit their needs.

Sometimes interviews targeted individuals who represented a cross-section of the departments. The goal of these interviews was to document the process and effects of the change initiative on the department. All interviews were semi-structured. Appendix B provides interview protocols for the various interviews.

Teaching and Learning Survey

Questions on the teaching and learning survey addressed personal teaching practices and department-level perspective with respect to quality teaching and innovation. The survey was administered to cross-section of faculty (including departments that were not involved in change.) One of the post-doctoral scholars was interested in which STEM skills instructors favored over others and created this survey to understand instructor priorities. Along with STEM skills questions (not used in this study), this survey included five questions related to teaching practices. The five questions are included in Appendix C.

Approaches to Teaching Inventory

Approaches to teaching inventories (Trigwell & Prosser, 2004; Trigwell et al., 2005) were administered to FLC members once in year 1, and in the beginning and end of year 3. The inventory determines whether an instructor's context (or course) specific approach to teaching is more information transfer/teacher-focused or conceptual

change/student-focused. Respondents answer various questions on a scale from one to five (one – only rarely to five – almost always). The teaching inventories provided information about the approaches to teaching of the individuals involved in FLCs (for the instrument, see Trigwell and Prosser (2004).)

Instructor Demographics and Co-Teaching Assignments

Instructor demographics and co-teaching assignments were collected from the registrar. Demographic data included title, hire year, and gender. This information was used to provide context to data collected from other methods. For example, if two individuals were involved in an FLC and collaborated to change a course, it may be that they have co-taught the course for many years and this influenced their cooperation within the change initiative.

Social Networks

The social networks of the five departments were collected through an online survey. The survey was sent to each member of the department (including professors, lecturers, laboratory coordinators, and post-doctoral scholars that were involved with the change initiative). Because the interest of the study was teaching practices, the social relationship of teaching discussions and advice seeking with respect to teaching defined the networks. On the survey, individuals identified others within the department with whom he or she discussed teaching and how frequently (monthly, weekly or nearly every day) in year two and three. In year three, respondents were also asked to whom they would go for advice about teaching.

Figure 3.4 is an example of a department survey form year three. In discussion networks, a department member is connected to another department member in the network if one of them reported that discussions about teaching occurred at least once a month (during the last academic year). In the advice networks, a directed connection from one individual to another is present if one individual seeks advice from another individual.

1. Your Name? _____

2. Please use the drop-down menus below to identify the people in the physics department with whom you DISCUSS teaching-related issues at least once a month and how often you talk to them about teaching. (There are 7 available slots, if you have more than 7 people to identify, choose the 7 people with whom you have the most important conversations.)

	Name	Frequency during the 2012/2013 Academic Year
1.	<input type="text"/>	<input type="text"/>
2.	Aristotle	Monthly
3.	Aristarchus of Samos	Weekly
4.	Archimedes	Nearly every day
5.	Aryabhata	<input type="text"/>
6.	Avicenna	<input type="text"/>
7.	<input type="text"/>	<input type="text"/>

3. Please list any other people (outside of the physics department) with whom you DISCUSS teaching-related issues at least monthly. Indicate: 1) the person's name; 2) frequency of discussion during the 2012/2013 academic year (Nearly every day, Weekly, Monthly).

- _____
- _____
- _____
- _____
- _____
- _____
- _____

4. During this academic year (2012/2013) how did the frequency of your teaching-related DISCUSSIONS compare to the previous academic year (2011/2012)?

Increased significantly	Increased Slightly	Stayed about the same	Decreased slightly	Decreased significantly
-------------------------	--------------------	-----------------------	--------------------	-------------------------

5. In the physics department, whom do you go to for ADVICE about teaching-related issues? Please use the drop-down menus below to identify these people. (There are 7 available slots, if you have more than 7 people to identify, choose the 7 people with whom you have the most important conversations.)

	Name
1.	<input type="text"/>
2.	Aristotle
3.	Aristarchus of Samos
4.	Archimedes
5.	Aryabhata
6.	Avicenna
7.	<input type="text"/>

6. Outside of the physics department, whom do you go to for ADVICE about teaching-related issues? Please list these people below. Indicate: the person's name

- _____
- _____
- _____
- _____
- _____
- _____
- _____

7. Please use the comment box below to add any other information that you think will help us better understand your responses.

Figure 3.4 Example of a social network survey from year three

Analysis

The analysis of data was separated into four stages. Each stage used multiple data sources in order to converge on findings (Yin, 2009). The first two stages include the development of a case study database (collection of raw data used as evidence to create a narrative) to increase the reliability of the findings (Yin, 2009). This narrative tells the story of the individuals and events that influenced the change in the department. In the first stage, the primary data sources were interviews and leadership artifacts to allow for theme development in the narrative through qualitative coding techniques (Corbin & Strauss, 2008). Narratives were developed using QSR International's Nvivo 10 software (NVivo qualitative data analysis software, 2012). In Stage II the narratives were informed by the survey data: social networks, approaches to teaching inventory, surveys, and demographic data. These data provided further articulation of the narrative or provided triangulation for the details of the narrative. Stage III consisted of theme development across narratives. These themes helped articulate the similarities and differences across departments. Finally, Stage IV related the narratives of each department to the two change strategies (the eight-stage leadership process and complexity leadership theory) and identified challenges and solutions that were framed by the strategies. This stage culminated in the answers to the guiding research questions addressed in the results section.

Stage I

The analysis of data sources guided the development of a narrative of change for each department. Each narrative described the context of the department, the efforts of individuals involved in the change initiative, and the changes made to department courses. To begin the process of writing the narrative, the data from each source were divided according to which department they addressed. For example, in meeting minutes of the advisory board, the board discussed the change efforts of each department. This means that this single data source addressed multiple units. The meeting minutes would be divided among the departments depending upon which department was the topic of discussion. If a single episode of the meeting addressed more than one department at the same time, then the data source could be assigned to more than one department.

After all the data sources were assigned to departments, the narrative was written to describe each department's change process. For leadership artifact and interview data sources, the coding process of grounded theory identified the emerging themes and ideas within the narrative (Corbin & Strauss, 2008). For example, Yin (2009) suggests using research design and analysis processes to inform each other. Because the department was chosen as the unit of analysis, it was expected that the department chair's activities would influence the type of change that occurred. Thus, data collection included information about the chair's activities related to the promotion of teaching inventory. For Department B, this expected theme also emerged from the data. However, in Department E an individual other than the chair had a large impact on teaching practices. This resulted in emerging themes that identified the informal leadership as important, in addition to the expected theme of the chair's activities.

This stage was not directly informed by either of the change strategies. However, it should be noted that the change strategies were identified prior to this stage. Therefore, they may have had some influence on the theme development. Member checks with individuals involved in the change initiative (after stage III) were used to ensure the narratives represented the change that took place in each department.

Triangulation was used to determine the content of the narrative. Triangulation could occur when a single data source mentioned an idea more than once, or if more than one data source mentioned the same idea. Collecting multiple data sources and triangulation of evidence were used to test construct and internal validity (Yin, 2009). Codes were identified separately for each department. The triangulation and themes of each department are discussed in the result section narratives.

Stage II

The teaching inventory, social networks and demographic data were used to inform the narrative after it was developed. The narrative of each department was used to identify areas in need of further description. For example, if an idea needed further articulation or support through triangulation, then the analysis of the stage II data was used to support or refute the claim. Answers to survey questions were not anonymous; therefore, an individual's responses could be identified to triangulate claims. Social networks required further analysis before they could be related to the narrative. This analysis is discussed below.

The social networks were analyzed to identify network-level structures (basic metrics and subgroups), as well as to identify important individuals within the network.

All analyses were completed using the UCINET computer software (Borgatti, Everett, & Freeman, 2002). Because this topic may be unfamiliar, this section describes the metrics that were used and gives examples of them in the five departments.

First, the network-wide characteristics of density and centralization were calculated. As an example of network-wide statistics, Table 3.2 provides a summary of these metrics in the year two discussion networks for the five departments. The density of a network is calculated by counting the number of ties present in the network and dividing by how many ties are possible (Prell, 2012). A denser network has more ties, or conversations about teaching occurring among its members (department C). This indicates that new teaching ideas could spread quickly. If the density of a network is very low (department A), ideas may not spread well within the department.

Table 3.2 Summary statistics of the five social networks in year two

Department	Density	Centralization
A(n=44)	0.06	13.2%
B (n=14)	0.18	24.7%
C (n=20)	0.22	28.7%
D (n=32)	0.12	25.4%
E (n=34)	0.11	14.4%

Centralization is a measure of the extent to which the ties of the network are concentrated in a few nodes (Prell, 2012). If a few nodes in the network are responsible for almost all the ties, then centralization is high. These nodes are likely to be very important in determining how information is spread in the network. Department D has a centralization that is nearly doubled that of department E, even though the two

departments are nearly the same size and density. This indicates that a few nodes in Department D have many connections, while most other nodes only have a few ties. These very active individuals have high influence over what information is distributed through the network.

Second, the networks were analyzed to identify subgroups. A subgroup is a portion of a network that has many ties amongst its members but only a few ties to other portions of the network (Prell, 2012). Because of the many connections within a subgroup, it is likely that the individual members of the subgroups share ideas and opinions about teaching practices (Christakis & Fowler, 2009). On the other hand, because of the lack of connections to other portions of the network, it is possible that separate subgroups will not share opinions. Social network researchers have identified several different methods for distinguishing subgroups (e.g. cliques, k-cores, lambda sets, etc.) (Prell, 2012). The Girvan-Newman approach was used here for identifying subgroups (see Newman and Girvan (2004) for algorithm details). A benefit of this approach is the assignment of each node to a unique subgroup and no predetermined number of subgroups. Figure 3.5 provides an example of Girvan-Newman subgroups indicated by the shape of the node.

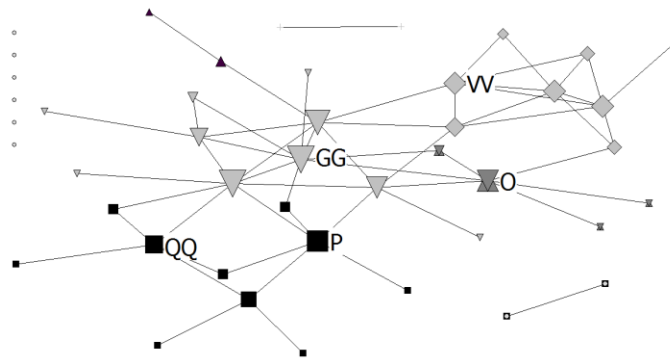


Figure 3.5 Department A (year two) with subgroups (indicated by shape of the node) and one set of well-connected individuals with representation from each subgroup (nodes with visible labels)

Third, the networks were analyzed to find well-connected individuals. A well-connected person is someone with many ties (Prell, 2012). A sampling of the opinions and ideas of the network that is likely to be representative of the network can be identified through conversation with well-connected individuals. However, if subgroups exist, this may be an indication of varying opinions between different areas of the network. In this case, the well-connected individuals chosen must be from each subgroup in the network. Figure 3.5 shows department A in year two (a network with many subgroups). Well-connected individuals in Figure 3.5 are indicated by the size of the node. The nodes that are identified by letters represent an example of a set of well-connected individuals that also represent the major subgroups of the network. These well-connected individuals are hubs of knowledge because they have access to information in the network (Stephenson, 2005).

Finally, the frequency of discussions was used to identify strong ties between individuals. In the survey, a discussion was defined as occurring monthly, weekly, or

nearly every day. For most analysis, only monthly ties were considered. However, stronger ties may indicate individuals that are important in the network. Figure 3.6 shows the difference between ties in department C that occurred once a month as opposed to ties that occurred weekly. The nodes that are connected in the weekly conversations are more active in conversations about teaching.

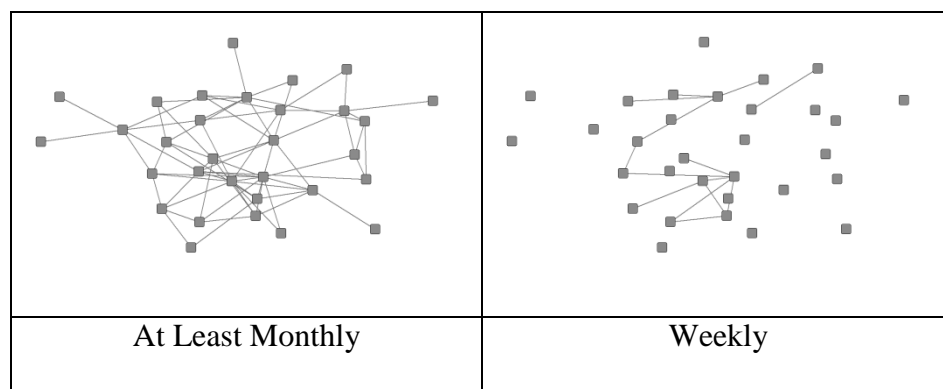


Figure 3.6 Department A (year three) networks based on frequency of discussions

In summary, the analysis of social network included: overall characteristics, group structure, well-connected individuals, and the frequency of conversations. This analysis was completed for two years of discussion networks and one year of advice networks.

Stage III

Stage III identified themes across the units of analysis. The department narratives were compared to find similarities and differences. Sometimes differences were used to identify themes in a department that may have been overlooked in the individual case analysis. Also, the contexts of the departments (size, attitudes towards teaching, etc.)

were examined for possible patterns relating context to narrative themes. In this stage, the choice of unit of analysis was addressed to understand if change seemed to be the same across every unit or more individual-based. This stage also included member checks with individuals involved in the change initiative. This was used to ensure that each narrative represented the change that occurred.

Stage IV

In the final stage of the analysis the research questions were addressed. The questions asked how the strategies describe change and frame challenges and solutions. In order to answer these questions, each department narrative was examined for evidence of the features of the change strategies. This process included pattern matching of the features of each department's narrative to the key characteristics identified in each strategy (Table 2.6). This stage tactics of using rival theories to understand a single case is a test of external validity of the analysis (Yin, 2009).

Pattern matching between theoretical frameworks and narratives is a common analysis technique of case studies (Yin, 2009). In this study, the theoretical frameworks are the eight-stage leadership process and complexity leadership theory. Each of these strategies is based on assumptions about how change occurs. These assumptions created differences in how the key characteristics of change were defined in each strategy (such as new ideas, decision features, and roles of the leadership). Pattern matching of these key characteristics to each department's narrative articulated the relationship between the strategies and change in higher education to answer the research questions.

For example, in complexity leadership theory, new ideas should develop throughout the change process. With this lens, the development of new ideas in the change narratives was highlighted as an important leadership activity. However, if new ideas were not developed, this is noted as a missed leadership activities. Missed leadership activities were used to understand how the two strategies framed challenges. Next, the strategies were used to identify potential solutions and examples from the narratives where these solutions had been enacted. The results of Stage II, III, and IV follow in the results and discussion sections.

CHAPTER IV

RESULTS

The results of the case study are presented in two sections. The first section (Instructional Change in Five Departments) highlights the change in each department and the important leadership activities of change according to each of the change strategies. This includes challenges that were faced by the departments as well as activities that the department enacted to address the challenges. This section concludes with a summary of results that address the first research question: Within the context of a higher education change initiative, how is the process of change described from the perspectives of two distinct leadership theories?

The second section of results (Challenges and Solutions) identifies the themes of the challenges that were faced by the departments. When possible, an example of a department that had addressed the challenge with enacted leadership activities is provided as potential solutions to the challenge. Examples of solutions are provided from both the perspective of the eight-stage leadership process and complexity leadership theory. This section concludes with a summary of results that address the second research question: How do these descriptions frame problems and solutions associated with change?

Instructional Change in Five Departments

In this section, the description of each department's process of change is discussed separately through individual departmental narratives. These narratives include the activities and individuals involved in change. Key department members are provided with pseudonyms for ease of reference. However, all department members have a code name that consists of two sets of letters. For example, a key individual is named Hannah for ease of reading in the narrative, but Hannah's code name is B_H. When individuals in a department play minor roles in the narrative, they are referred to by their code name, instead of given a pseudonym. This allows the reader to differentiate between key actors in the change narrative and those with smaller parts.

Each department description begins with a summary of change in that department (more detailed descriptions of the departments are included in Appendix D). The summary of change provides a narrative of the events and individuals involved in change in the department. In the department narrative, vagueness in the identity of individuals as sources of information is maintained to protect their identity as much as possible (especially for individuals who requested that their comments remain confidential).

Following the summary, each of the two change strategies is used to identify enacted and missed leadership activities in the department. In the last portion of the department's description, the missed and enacted leadership activities in the department are summarized. This section concludes with an overview of enacted and missed leadership activities according to the two change strategies that occurred in the five departments.

Department A

Department A has 60 members. The change initiative focused on improving seven courses (A101L and A102L, A201 and A202L, A301L, A302, and A303). Nine members of department A were involved in the change initiative. This includes the PI of the project. The members of one of the sub-disciplines in department A were particularly active in the change initiative (this is referred to as “sub-discipline A” throughout the results section). Table 4.1 provides a summary of change initiative participants’ demographics in department A.

Table 4.1 Individuals who will be discussed in department A’s change narrative and their role in the change initiative

Name	Title	Change Initiative Role(s)	Sub-discipline A Membership
Alexis	Lecturer	Manage A101L/A102L and A201L/A202L	
Michael	Associate Professor	FLC member (Laboratory), Teach A301L/A302	X
Kara	Associate Professor	FLC member (300 level lecture), Teach A303	
Jackson	Professor	PI	
Clark	Associate Professor	FLC facilitator (Laboratory)	X
A_Y	Professor	FLC member (Laboratory)	
A_VV	Professor	FLC member (Laboratory)	X
A_AAA	Professor	FLC member (300 level lecture)	
A_PP	Professor	FLC member (Introductory lecture)	
A_Z	Beginning Chair	NA	
A_FF	Concluding Chair	NA	X

Setting the Stage

In department A, several change initiative participants were interested in making instructional changes before the change initiative began. For these faculty members, the change initiative acted as a catalyst to support the change that they were already interested in making. For example, Alexis is the lecturer in charge of four courses that were changed within the department (A101L/A102L and A201L/A202L). Alexis had already begun to discuss the possibility of improving these service laboratory courses with faculty members. The same was true for the two courses taught by associate professor, Michael. For the laboratory course, (A301L – with 6-15 students), Michael felt that the course represented more of a science “club” rather than a course where students learned to act like scientists. He began to think about how he would improve the course through a research experience before the change initiative occurred. His other course, (A302 – 40 student lecture), had recently been split from one semester into two semesters. With less content to cover, A302 had more flexibility to add new teaching techniques, which influenced its appropriateness for adding inquiry-based projects. Finally, Kara, an associate professor who taught A302, also mentions having been interested in improving her lectures through active learning prior to change. The key individuals were already considering making changes to their courses before the change initiative occurred.

The Beginning Years (Years 1 and 2)

The courses changed in the beginning years included Alexis’s laboratory courses and Michael’s lecture and laboratories. In the beginning, some activities did not

necessarily lead to entire course changes. For example, A204 was identified as a possible course for improvements related to the change initiative. Some Nature of Science activities were added to A204, but it was not identified by the change initiative as a participating course. This may be an indication of indirect impact of the change initiative on the department.

Jackson was important for recruiting the change initiative participants from department A. He is a member of the department and the PI of the change initiative. According to the social network of the department (Figure 4.1), Jackson is a hub of knowledge because of his many discussions about teaching. Jackson used these discussions to identify individuals who were interested in change and to understand the type of support these individuals needed from the change initiative. For example, Michael needed laboratory equipment for his research course to be successful. When Jackson became aware of this need, he allocated funds from the change initiative that enabled Michael to create a research project for the course. Jackson's discussions also led to identifying Alexis as an individual who was interested in making changes to her laboratory courses. Jackson's role as a hub of knowledge helped him identify ways that the change initiative could encourage change through providing funds or support.

In addition to Jackson's personal connections to identify potential change for department A, one of the main goals of the Laboratory FLC was to learn about what people were already doing and to learn from local experts on Nature of Science. This group felt it was important to seek out expert knowledge before attempting to make changes.

Concluding Years (Years 3 and 4)

In the concluding years, the original developers in department A continued many of the same course changes. This shows commitment of the people involved in change to continue to make changes. Also, the sub-discipline A course (A301L) will be transferred from the original developer (Michael) to a second instructor (Clark) in the year following the change initiative. Clark could adopt the course easily because he helped Michael with the development of the research project in the beginning years.

During the concluding years, Kara's course, A302, hired learning assistants through the change initiative. These learning assistants are expected to continue to be used by the instructors of A302 in the future. Kara valued being part of the learning community. It gave her the opportunity to think about and share what was working and what was not working and make changes throughout the implementation. The following semester, the other instructor of the course also used the learning assistant. Kara believes the use of learning assistants will continue in the course, and she will continue to use them herself.

Department A members began to talk about the challenges of training TAs in the beginning years. The FLCs spoke about how to train them (ask graduate students themselves, or seek advice from other departments) and Alexis struggled with training them to use inquiry-based techniques. At the conclusion of the grant, the TA training challenge had not been resolved.

Michael achieved tenure during the change initiative process. He recognizes that as a non-tenured faculty member, it may not have been wise for him to focus on extensive instructional changes. Although, he felt motivated to do so based on his belief

about how courses should be taught. He does believe that being involved in a prestigious university-wide grant may have helped him earn tenure, but the changes in the classroom were not as important.

In the concluding years, the social network of department A had more overall connections and more connections across subgroups. For example, the average number of individuals named by a respondent increased from 3.5 in the beginning years to 4.9 in the concluding years. Jackson continues to be an important hub of information-- for both the discussion and advice network (Figure 4.2 and Figure 4.3). Sub-discipline A continues to be a subgroup of the network (gray in discussion network Figure 4.2, and pink in the advice network Figure 4.3). This means Jackson is still very important for spreading information in the network and that sub-discipline A remains removed from the rest of the department. It is noticeable in the advice network that the connectors between sub-discipline A and the rest of network consist of the connection of Kara and Michael (marriage) and Hannah of department B. This indicates that changes adopted and discussed by sub-discipline A may not be shared with the rest of the department.

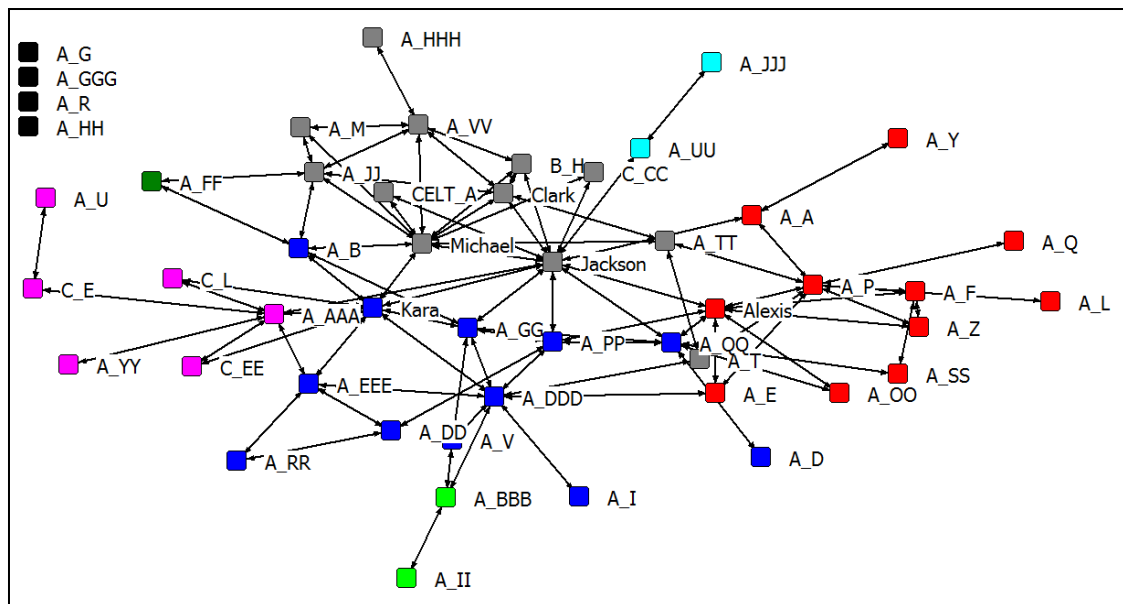


Figure 4.2 Discussion network of department A during the concluding years

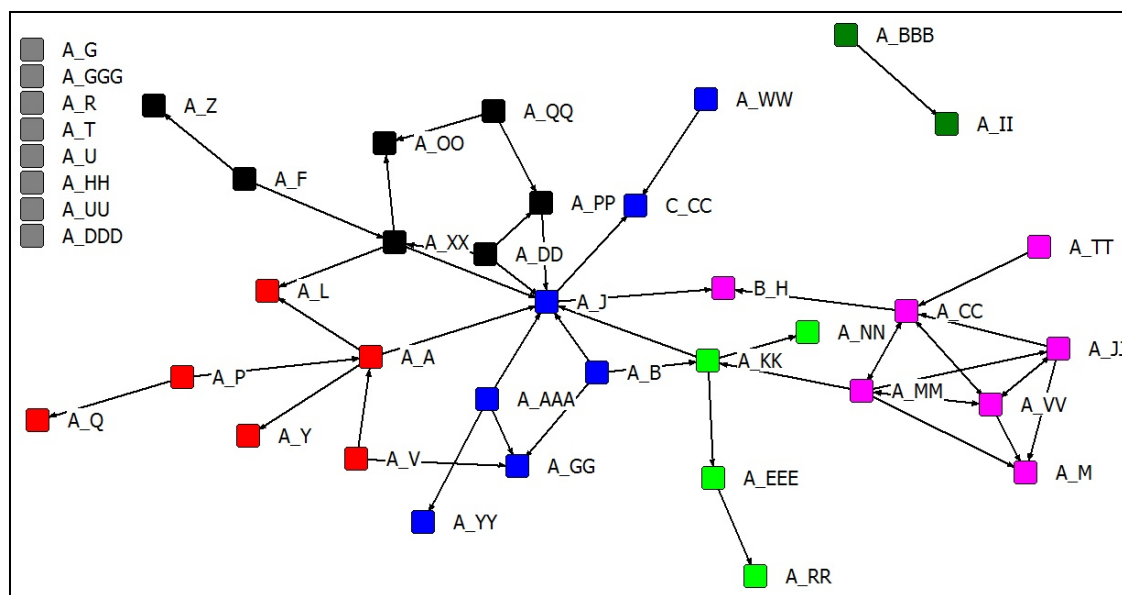


Figure 4.3 Advice network of department A during the concluding years

Department A and the Eight-Stage Leadership Process

Create vision. To create the vision, the guiding coalition establishes a sense of urgency articulates the vision and develops a strategy for implementation. Department A had the benefit of having an important hub of knowledge in their social network (Jackson) involved in change. His connection with others in the network gave him informal authority to promote the vision of the change initiative to the department. This role is usually fulfilled by middle level individuals (in the case of universities, department chairs). In department A, the chair was not involved in change. Therefore, the change relied on the connections of Jackson to be the powerful member of the guiding coalition.

Implement change. To implement change, the guiding coalition communicates the vision, rewards compliance and provides resources. In department A, the guiding coalition (through Jackson's personal connections and FLC activities) was successful in identifying what resources were needed to encourage change. Jackson did not have to communicate the vision to these individuals because they were already making changes that matched the vision. (Michael bought equipment, Alexis attended a workshop and Kara hired learning assistants.) These resources were identified by both Michael and Kara as being necessary for change. For Alexis, change had already begun but the workshop added additional motivation. A missed opportunity in department A was the promotion of the vision to individuals who were not already interested in making changes.

Rewarding successful change may explain why the Nature of Science changes made in A204 were not formally recognized. Although these changes were not completely outside of the goals of the change initiative, they did not meet the main goal of five to six week research or inquiry-based projects. The guiding coalition did not recognize this change, but rather focused on the larger project-based changes (or in the case of Kara, active-learning). In this way, they promoted their overall vision to the change initiative participants.

Institutionalize change. The guiding coalition institutionalizes change by formally changing the structure of the organization. In department A, evidence of institutionalization is present among sub-discipline A. In this sub-discipline, Clark plans to continue Michael's changes in the following semester. (Furthermore, although not an official change, A204 also transferred from the original implementer to a second instructor.) Kara indicated that the following instructor would also use the change she started with learning assistants. This transfer indicates some institutionalization because the change survived a change of personnel.

It is unclear how long these changes will continue. Some of the most extensive changes that were made by Alexis rely on her involvement. On the one hand, she has full control over the laboratory courses and the authority to institutionalize change. (There is no opportunity for transfer.) This makes it difficult to judge whether the changes will continue, especially if Alexis were to leave the department or if her job description changed. Because the guiding coalition did not involve any formal leaders in the

department, it is difficult for formal changes to be made to the way courses are taught. This is a missed leadership activity that could have promoted change.

Department A and Complexity Leadership Theory

Facilitate conditions to create change. To facilitate conditions to create change, the leaders create connections between individuals, remove stifling conditions, and disrupt existing patterns. In department A, sub-discipline A already was engaged in conditions that were conducive to developing emerging knowledge. They meet weekly with the entire group and have many discussions across the group. The change initiative encouraged these conditions by involving individuals from the group in the FLC. This provided them with expert knowledge to make changes to courses. Providing expert knowledge gives individuals the tools to solve problems. In complexity leadership theory, this is a part of encouraging dissenting opinions. Although expert knowledge does not necessarily lead to dissenting opinions, it does provide diversity of knowledge that creates tension and can lead to knowledge creation. For this reason, providing expert knowledge will be labeled under the category of encouraging dissenting opinions.

In two of the courses changed by sub-discipline A (A204 and A301L), changes were made collaboratively by two instructors. Involving more individuals in change provided conditions that were conducive to creating emerging knowledge in how to develop a successful course.

In the other course changes, instructors mostly acted individually. Kara and Michael attended the FLCs but report that most of their ideas were not identified during

the FLC. It is possible that their changes helped other departments make changes, but the department A members already had their changes in mind when the initiative began.

Alexis gained some new knowledge from the summer institute. A missed opportunity in department A was partnering Alexis with other instructors to share the knowledge she gained at the summer institute.

Identify emerging knowledge. When the conditions exist to create new knowledge, the role of enabling leaders is to identify potentially valuable knowledge (to meet the “simple rule” established by the change initiative leaders). A simple rule is a guideline for participants to follow that is promoted by leaders but is flexible to allow for many actions to fit the rule. In the change initiative, the simple rule was “it takes a village to raise a scientist.” The role of enabling leaders is identifying and amplifying ideas that match the simple rule.

The design of the FLC and the actions of Jackson were aimed at identifying individuals who were already engaged in change. This was a successful method for identifying Michael and Alexis, who had ideas for how to make change in their courses, and Kara, who had already been engaged in active learning techniques. Part of identifying emerging knowledge, is also providing resources for this knowledge to be implemented by the developers. This means providing funding for the changes in the courses. It is possible that Jackson’s personal connections limited the emerging knowledge that was identified. It may have been useful to encourage other individuals to help identify useful knowledge beyond the reach of Jackson’s personal connections.

Communicate knowledge. Once this new knowledge is identified, the enabling leaders share the knowledge with the rest of the organization, especially the formal leadership. This is an area where the change initiative may have missed an opportunity to support change. Jackson explains that Alexis's efforts were shared with other FLCs and used to encourage their changes. However, for departmental changes, it may have been just as important to communicate Alexis's successes with the rest of the department. This communication was made more difficult by the lack of formal assessment of impacts on the students. Communication of the knowledge would have benefited from both assessment and discussion with the department.

Implement knowledge. Complexity leadership theory also must make formal changes to the structure of the organization to be successful. However, in department A this usually did not happen because the formal leadership was not involved in changes. The transfer that happened in sub-discipline A occurred because of the collaboration between individuals at the early stages of development. The environment created by the weekly group meetings of the sub-discipline helped create an environment where discussions and collaborations could occur. This sub-discipline's connection likely facilitated the communication of knowledge and also the implementation of knowledge by multiple individuals. However, this same communication was not shared by all of the department or the courses that were not related to sub-discipline A. This communication is only a partial solution to the challenge of implementing knowledge because it did not involve most members of the department.

Summary of Enacted and Missed Leadership Activities

The summary of the challenges to the process of change and the features of the department that supported change are listed in Table 4.2. According to the eight-stage leadership process, department A enacted leadership activities by (a) using Jackson's connections to promote change and (b) providing resources for changes that met the vision of the guiding coalition. However, missed leadership activities included (a) communicating the vision to more individuals in the department to create even more change, and (b) involving formal leaders in the guiding coalition to ensure that there is a mechanism for changes to be institutionalized.

According to complexity leadership theory, department A enacted leadership activities by (a) using the existing weekly interactions of sub-discipline A to spread knowledge (b) using Jackson's connections to identify and support individuals who were interested in change, and (c) providing expert knowledge to create a diversity of ideas by supporting Alexis's trip to the summer institute. Missed leadership activities according to complexity leadership theory included (a) encouraging individuals to share information through interactions in the department (b) assessing changes to share knowledge with formal leaders, and (c) encouraging changes by different individuals beyond the initial adopters.

Table 4.2 Summary of enacted and missed leadership activities in department A

Eight Stage Leadership Process		
Stage	Enacted Leadership Activities	Missed Leadership Activities
1.Establishing a Sense of Urgency		
2.Creating the Guiding Coalition	Include informal education leaders in the guiding coalition (Jackson)	Include the department chair in the guiding coalition
3.Developing a Vision and Strategy	Adopt the vision created by the change initiative Co-PIs	
4. Communicating the Change Vision	Communicated through Jacksons personal connections	Use the formal leaders to communicate the vision
5. Empowering Broad-Based Action	1. Provide resources to buy equipment for research activities 2. Provide funds for attending summer institutes to inspire change	
6. Generating Short-Term Wins		Assess changes to share with the department
7. Consolidating Gains and Producing More Change		Communicate change successes to expand changes within the department
8.Anchoring New Approaches in the Culture		Involve formal leaders or communicate the need for changes to the formal leaders
Complexity Leadership Theory		
1. Disrupting patterns to encourage interactions between individuals		
2. Developing rules that create interdependency to encourage teamwork	Sub-discipline A's weekly meetings that included teaching concerns	

Table 4.2 – Continued

3. Encouraging dissenting opinions to increase tension	Provide expertise to create knowledge and provide diversity of ideas through the summer institute attendance	
4. Avoiding stifling regulation with a simple rule		
5. Articulating the vision		Communicate the vision beyond sub-discipline A
6. Identifying emerging knowledge from interactions	Identify and support individuals interested in change (Jackson)	Identify possible changes that occurred beyond Jackson's personal connections
7. Communicating emerging knowledge to formal leadership		Assess knowledge in order to communicate new knowledge with the department
8. Implementing knowledge	Using the existing weekly interactions of sub-discipline A to spread knowledge	Involve the formal leadership in implementing change

Department A created change through informal interactions and the structure of sub-discipline A. Jackson's connections in the department were important for identifying individuals who were interested in change and providing them with the support they needed to make changes. In sub-discipline A, current and future instructors of a course worked together on changes. This led to transfer of changes from the initial adopter of the changes to the next instructor. A common theme in the challenges that faced department A is the lack of support from formal leaders and communication about change beyond participants. Jackson was successful in encouraging changes in individual courses but not in spreading this vision to the rest of the department. In sub-discipline A, the lack of

formal support was replaced by the weekly meetings, allowing for transfer within the sub-discipline, but not beyond sub-discipline A.

Department B

Department B had twenty-five members during the fourth year of the initiative. (The department hired two new faculty members during the four years.) Large-scale curriculum changes in two of department B's courses were directly related to the change initiative (B100L and B300). Six members of department B participated in change initiative activities. Table 4.3 provides a summary of change initiative participants' demographics. The department chair changed during the first two years of the change initiative.

Table 4.3 Individuals who will be discussed in department B's change narrative and their role in the change initiative

Name	Title	Change Initiative Role(s)
Cora	Graduate Student	FLC member (Laboratory), Evaluate B100L
Hannah	Professor	Co-PI, FLC member (Laboratory), Teach B100L
James	Senior Lecturer	FLC Member (Laboratory), Teach B300
Tim	Professor	FLC Facilitator (Laboratory)
Everett	Professor	FLC Member (Introductory lecture) Add One Nature of Science Lecture
Wilson	Assistant Professor	FLC Member (300 level lecture)

Setting the Stage

Hannah, Tim and B_G are the three individuals of department B that have shown interest in education concerns in the past. All three identify education as one of their research interests. Hannah has been the most involved in instructional practices, listing education research as her primary interest and being involved in multiple efforts to improve teaching. She is a co-PI in the change initiative.

The Beginning Years (Years 1 and 2)

The changes in department B occurred early in the change initiative timeline (beginning within the first year). This includes the two course changes and the addition of one Nature of Science lecture in a third course.

The Nature of Science lesson was added by Everett to a course he was teaching after he attended the Introductory FLC. This is a relatively small instructional change, and is not discussed here. Hannah added a six week authentic research project to B100L (a 75 student laboratory) that had previously been a traditional “step-by-step” laboratory. Hannah recruited Cora (a graduate student) to help create and evaluate changes to the course. The other course, B300, was changed by James, who frequently discussed changes with Tim. B300 is an upper level course with 30 students. James added a six week research project to this course.

During the beginning years, Hannah recognized the training of Teaching Assistants (TAs) as a potential source of resistance for the planned change. She said at the beginning of the change initiative, she had little or no control over which TAs were

assigned to her lab. She felt that most TAs were underprepared to facilitate authentic research projects.

Participants also described the context of the department with respect to the change initiative. Although Tim describes the department as valuing teaching in tenure reviews, Hannah felt that the department was indifferent to her attempt to make changes in the course. Hannah, James and Tim felt most support came from outside of the department and from their participation in the Laboratory FLC. This helps explain why the change initiative participants, Hannah, Tim and James, are not central in the social network (Figure 4.4). Hannah and Tim are not connected with the chair of the department, but they both believe that involving the department chair in change will be important for motivating others to make changes throughout the department.

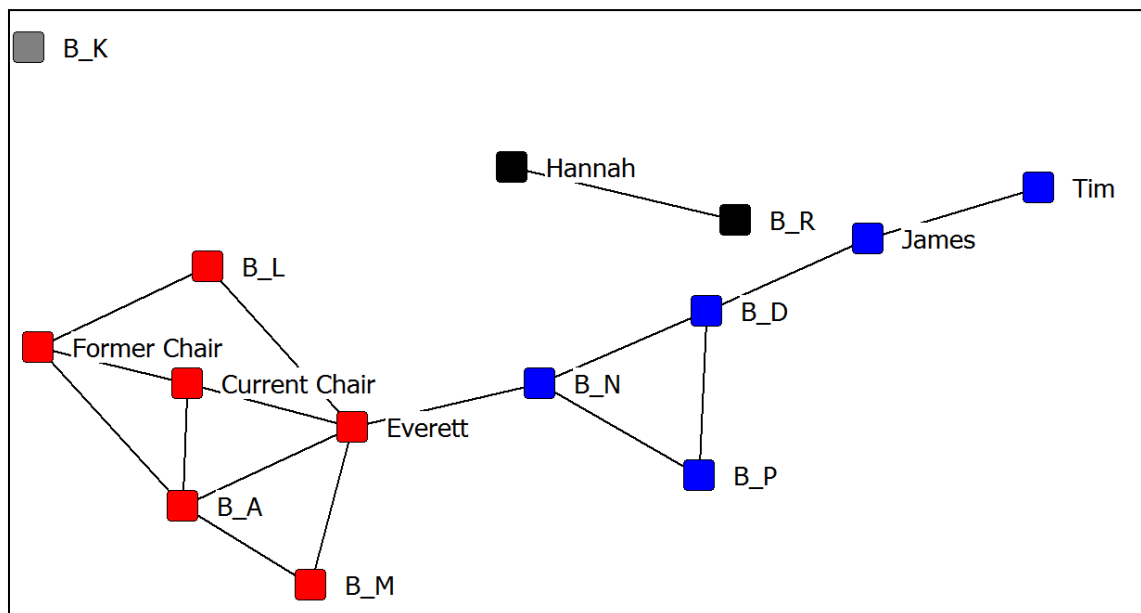


Figure 4.4 Department B discussion network during the beginning years

The Concluding Years (Years 3 and 4)

Hannah, James, and Tim continued to be involved in course changes and FLCs. Tim became the co-facilitator of the research FLC. Everett did not continue to attend FLC meetings. Wilson joined the department and also started attending the FLC that focused on 300 level courses. The course changes remained mostly the same, and Hannah and James worked to refine their six week research projects.

For Hannah, refining B100L included expanding changes to the other section of the course that was taught by B_L. At first, B_L was not interested in making changes to the course. Hannah feels that her persistence in making her project work is what finally made B_L agree to change her course as well. Although Hannah was interested in making these changes before the grant was funded, she believes that without financial support from the change initiative, this change would not have happened. To raise the visibility of the project, Hannah invited higher level individuals from the college to semester-end student poster presentations of B100L students. She hoped this would help sustain and support the type of instructional changes she was making.

Teaching assistant training did continue to be an issue. Hannah addressed this by trying to hire TAs from previous years to help with newer TAs. Cora (the graduate student) was hired as an instructor and continued to work with TAs. Hannah said it was unlikely that the changes she initiated would continue if she were to stop teaching the course. Her research colleagues remained uninterested in partnering with her on undergraduate research experiences in the classroom.

Hannah and Tim continued to turn to colleagues outside of the department for support (specifically, the Laboratory FLC participants). According to Hannah and Tim,

the few members that are interested in teaching in Department B are also involved in the FLC. Tim, James, and Hannah formed a subgroup within the social network (Figure 4.5). This may mean that they are unaware if others in the department are interested in instructional changes because they are not speaking with them.

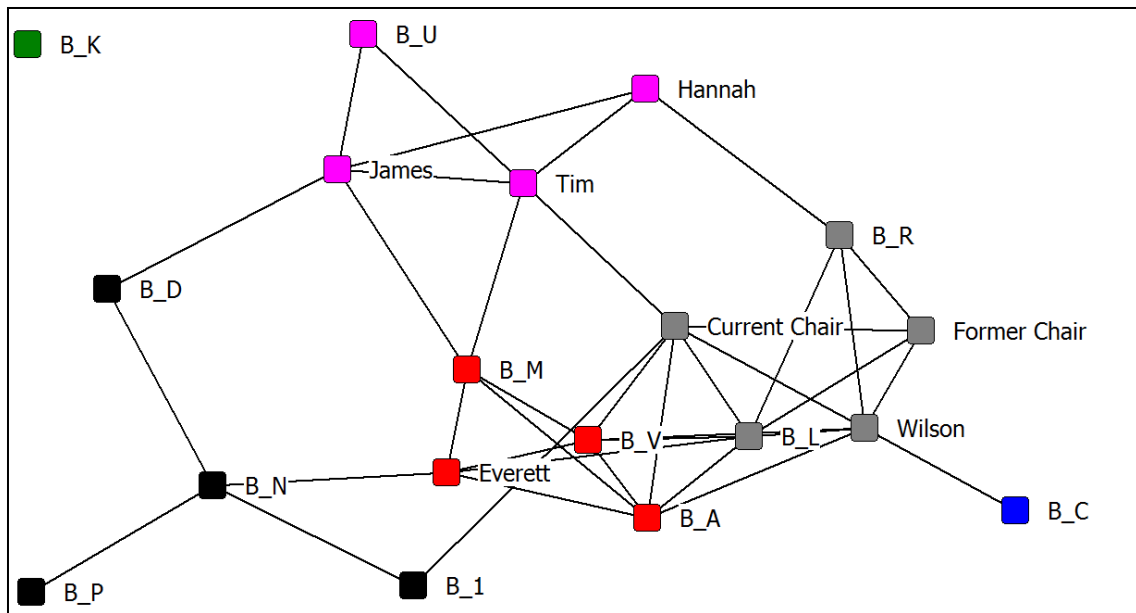


Figure 4.5 The discussion network of department B in year three during the concluding years

In the concluding years, twelve members of the Lab FLC collaboratively wrote and submitted an article on the experiences of changing lab courses. These twelve included Hannah, James and Tim. At the time of this report, the article was still under revisions for future publication.

Department B and the Eight-Stage Leadership Process

Create vision. Leaders in the eight-stage leadership process plan and manage change. In order to create the vision, the leadership creates a sense of urgency, a guiding coalition, and strategies to meet the vision. For department B, the co-PIs (including Hannah) act as the guiding coalition. Hannah was important to include in the guiding coalition because she is the education expert in the department. The guiding coalition created a sense of urgency with respect to the student outcomes at the institution, and shared this information with participants when they were recruited. The guiding coalition identified six week projects as the vision for the change initiative and this is generally the change that department B made. This means that the type of change that occurred was chosen by the guiding coalition. This decision was made before the change initiative began, which represents prescribed change.

However, one of the themes of department B is the concern about the chair's involvement. In the beginning, participants recognized that chair buy-in would be important for encouraging change. The chair was not part of the guiding coalition; this is a missed leadership opportunity according to the eight-stage leadership process. Without the support of the chair or college-level individuals in the guiding coalition, it is difficult for change to occur in department B.

Implement change. To implement change, the leader creates and celebrates short-term wins, provides resources and rewards compliance. The guiding coalition did provide resources for purchasing equipment and the FLC for support. The FLC also provided

rewards and encouragement for compliance through the opportunity to publish a journal article. The guiding coalition rewarded and encouraged Hannah and James for making changes by featuring their efforts in advisory board meetings and at retreats.

The department provided support for change by allowing Hannah to hire some of the same TAs from year to year. The department also hired Cora to teach a course after graduation. This allowed Hannah to use the resource of Cora's experience throughout the change. However, most of the support for change came from the change initiative and not from the department.

The change initiative leaders allowed the FLC to have the freedom to identify specific strategies. This freedom does not fit into the eight-stage leadership process. A missed leadership opportunity according to the eight-stage leadership process would have been clearly articulating the expected outcomes of the FLC.

The guiding coalition also tried to build momentum through a retreat. Interviews with the guiding coalition indicated that the goal of this retreat was increasing the level of communication between participants and encouraging continued change. The retreat was not identified by any of department B member as being important for change.

Institutionalize change. Change is complete when new ideas become institutionalized. The main changes made in department B were limited to the two courses. Hannah actively pursued new collaborations throughout change. However, frequently her colleagues were unwilling to dedicate time to the inclusion of the vision (six week research modules). This is an indication that change was not institutionalized. According to the eight-stage leadership process, the reason that this occurred is because

the guiding coalition was not powerful enough to influence change in the department. The lack of “power” in the guiding coalition to influence participation is a missed leadership activity.

Department B and Complexity Leadership Theory

Facilitate conditions to create knowledge. Leaders in complexity leadership theory facilitate conditions to create knowledge. This includes fostering interactions and avoiding stifling environments. In department B, new ideas are being facilitated through the involvement in the FLC. The FLC provides structure that encourages individuals to interact with one another and gain knowledge. This is an influence of the change initiative on the process of change.

FLCs were run by faculty co-facilitators. These co-facilitators were members of the group that was expected to change, who (according to complexity leadership theory) have the necessary skills to create knowledge. The FLC was charged with following the “simple rule” of “it takes a village to raise a scientist.” The guiding coalition did not dictate the direction of the FLC and only provided a general sense of direction (by framing the FLC as focusing on laboratory work).

Within the department, the social network’s subgroups are a stifling condition. The interaction opportunities that could be fostered within the department are not being used. This is a leadership activity of complexity leadership theory that is missing from the process of change in department B.

Identify emerging knowledge. Next, the leader identifies emerging innovations that are developed by adaptive leadership and promotes them through communication with the administrative leadership. Because the department B changes represented the initial goals of the change initiative, it is unclear if the vision was created in the FLC or was created by the guiding coalition. It is likely a combination of both. The FLC is where the knowledge was created to do all of the intermediate steps of change. However, the main goal of change matched the initial expected outcome of the guiding coalition.

Within the department, the subgroup of innovators shared and implemented one example of emerging knowledge. This was the change in the TA training. Before the initiative, TAs were trained very briefly and the instructor had little control over the TAs that were assigned. However, near the end, a change to the system allowed Hannah to rehire TAs and assign a TA as a supervisor.

Communicate knowledge. Communicating knowledge was hindered by the subgroup and isolation of the developers. The enabling leadership did not connect with the department chair, dean, or other formal leaders. This attempt was made through student presentations, or by change initiative leaders, however, there is little evidence that the communication was successful. This could have been used as a way to build momentum for developing and shaping the shared vision. However, without communication outside of the subgroup department B did not develop a shared vision.

Implement knowledge. For complexity leadership theory, implementing knowledge is intended to indicate structural changes to the organization. In department B,

structural changes were made to the two courses involved in change. There is also evidence that change was made to TA assignment. This is limited implementation because it does not affect most of the courses or expectations of department B. In addition, Hannah suggests that once she does not continue with the changes, the course will not exist in its current form.

The ability to implement these changes was limited by the decisions of potential collaborators. Knowledge that was communicated with potential collaborators did not always result in the decision to implement changes. This was especially true when Hannah was searching for partners to do authentic research. This may be because the knowledge was not properly promoted in the communication phase.

Summary of Enacted and Missed Leadership Activities

The summary of the challenges to the process of change and the features of the department that supported change are listed in Table 4.4. According to the eight-stage leadership process, the change initiative was successful in communicating the vision, providing resources for change and rewarding change. This included (a) having the education expert (Hannah) in the guiding coalition (b) communicating the vision to the FLC participants, (c) providing money to buy equipment for research projects, (d) providing funding to hire Cora (e) rewarding change through acknowledgment at change initiative guiding coalition meetings and (f) hiring TAs who had taught the course in previous years. Except for the assignment of TAs these leadership activities were enacted by the change initiative (not the department). The missed leadership activities consist of involving other members of the department in change. These missed activities

included (a) involving the formal leaders of the department in the guiding coalition to communicate and institutionalize change (b) communicating the vision to individuals who were not involved in the FLCs and (c) rewarding individuals within the department for making changes.

According to complexity leadership theory, the enacted leadership activities in department B included: (a) creating interactions to encourage knowledge development in the FLC, (b) providing a simple rule for the FLC to guide development of changes, (c) identifying emerging knowledge in the FLC and (d) identifying the need for TA training to change in the department. However, as with the eight-stage leadership process, most of the leadership activities were led by the change initiative and not the department. These missed leadership activities include: (a) encourage dissenting opinions by creating interactions between the chair and the change participants (b) identifying and communicating emerging knowledge with the department members and (c) including the formal leaders in communication and implementation.

Table 4.4 Summary of enacted and missed leadership activities in department B

Eight Stage Leadership Process		
Stage	Enacted Leadership Activities	Missed Leadership Activities
1.Establishing a Sense of Urgency	Promote the change initiative's sense of urgency (scientific thought) through FLC meetings	Promote the change initiative's sense of urgency beyond the FLC members
2. Creating the Guiding Coalition	Have education experts (Hannah) in the guiding coalition	Include the department chair and informal leaders in the guiding coalition
3. Developing a Vision and Strategy	Adopt the vision created by the change initiative Co-PIs	

Table 4.4 – Continued

4. Communicating the Change Vision	Use an FLC to communicate the vision with implementers	Communicate the vision through the formal leaders of the department
5. Empowering Broad-Based Action	1. Provide resources to buy equipment for research activities 2. Provide resources to hire graduate students to assist in change.	
6. Generating Short-Term Wins	Recognize early adopters in change initiative meetings	Recognize early adopters at faculty meetings
7. Consolidating Gains and Producing More Change		
8. Anchoring New Approaches in the Culture	Hire the same Teaching Assistants from year to year to transfer course-specific knowledge	Involve the department chair in promoting the transfer of implementation from one instructor to the next
Complexity Leadership Theory		
1. Disrupting patterns to encourage interactions between individuals	Create interactions to encourage knowledge development in an FLC	Involve more individuals in the FLC
2. Developing rules that create interdependency to encourage teamwork		
3. Encouraging dissenting opinions to increase tension		Involve more individuals in the FLC who have dissenting opinions about appropriate changes
4. Avoiding stifling regulation with a simple rule	Provide a simple rule that does not stifle knowledge creation in FLCs	
5. Articulating the vision	Provide a simple rule for an FLC to guide development of changes	Communicate the vision beyond the FLC members
6. Identifying emerging knowledge from interactions	Identify emerging knowledge in an FLC (TA training)	Identify individuals interested in change beyond the FLC members

Table 4.4 – Continued

7. Communicating emerging knowledge to formal leadership		Communicate new knowledge in interactions of the FLC and faculty meetings.
8. Implementing knowledge		Involve the chair in change initiative activities to formalize changes

In department B, a small group of individuals interested in changes supported each other within the department and through the FLC. The change initiative guided the changes made by the participants, and little support was provided from the department. The main challenges to change were spreading the involvement in the department beyond the few individuals who were willing to make large-scale changes. Jackson (PI) believes part of the problem may be that the chair and other members of the department were more concerned about encouraging the transfer of mathematics content to the discipline, and not creating five or six week projects.

Department C

Department C changed six laboratory courses (C101L, C111L and C112L, C201L, C301L and C302L). Department C has 40 members. Fifteen members were involved in the change initiative, including a co-PI, as well as two post-doctoral scholars. Table 4.5 provides a summary of change initiative participants' demographics. One sub-discipline of department C collaboratively made changes to C301L and C302L. This sub-discipline is referred to as sub-discipline C. Membership in sub-discipline C is identified in Table 4.5.

Table 4.5 Individuals who will be discussed in department C's change narrative and their role in the change initiative

Name	Title	Change Initiative Role(s)	Sub-discipline C Membership
Barney	Professor	Post-doc advisor (Nancy), Teach C101L	
Marcus	Post-doc	Year 2, FLC member (Laboratory), FLC facilitator (GTALC), C111L/C112L and C201L, C301L/C302L	
Nancy	Post-doc	Year 2, FLC member, FLC facilitator (GTALC), C111L/C112L TA training	
Cedric	Professor	Co-PI, FLC facilitator (Introductory lecture), FLC member (Laboratory/Research), Post-doc advisor (Marcus), C111L, C112L	
Curtis	Professor	FLC member (Laboratory/Research), Teach C201L	
Isaac	Chair	FLC member (Laboratory) C301L, C302L	X
Louis	Assistant Professor	FLC facilitator (300 level lecture) C302L	X
C_O	Professor and Former Chair	Assisted Marcus	
C_DD	Professor	FLC member (300 level lecture)	
C_N	Lecturer	FLC member (300 level lecture)	X
C_R	Assistant Professor	FLC member (300 level lecture)	X
C_KK	Assistant Professor	FLC member (300 level lecture)	
C_K	Senior Lecturer	FLC member (Introductory lecture)	
C_X	Professor	FLC facilitator (Laboratory), Post-doc advisor (Marcus) (left after first year)	X
C_OO	Teaching Laboratory Manager	Attended some FLC meetings (Laboratory)	

Setting the Stage

In the past, members of Department C have been involved in various activities to improve student learning. Cedric and Barney (education researchers) have taught their courses with inquiry-based activities and active learning techniques. C_K (senior lecturer) has also been involved in previous projects focused on teaching techniques. In the past, Cedric has shared some information on instructional techniques with other department members. It has always been optional whether individuals want to adopt changes or not. Teaching has traditionally been thought of as an individual effort in department C.

The Beginning Years (Years 1 and 2)

In the beginning of the change initiative, the participants from department C had many concerns about what change was appropriate for the department. One concern was how to ensure student safety while creating more open-ended activities. Several department members claim they cannot change laboratories in department C because granting students who have low content knowledge too much freedom to design and carry out experiments would be dangerous. Along with this safety concern, they felt that other change initiative participants (who were non-department C members, particularly Jackson the PI of department A) did not understand the considerations needed for a successful laboratory in department C. Therefore, the recommendations from other departments were not applicable to department C.

The department members felt like a goal of authentic research in the classroom was not possible in department C. This was partly due to safety, partly because of the size

of the laboratories, and partly because of how much effort it would take to maintain an authentic research experience. Instead, the participants described the goal of the changes in department C as the inclusion of inquiry-based projects rather than authentic research. This would allow the department to have control of safety concerns and the project could be used from year to year without needing to be revised. Ultimately, they hoped this would cater to the development of undergraduates who could participate in research under a specific faculty member.

This led the department to focus on moving towards inquiry-based laboratories in the 300 level laboratories and the introduction laboratories for non-majors (C111L/C112L and C301L /C302L). The introduction laboratories were changed by Marcus (post-doc) and Cedric (education researcher). The 300 level courses were changed collaboratively by the faculty members whose expertise was in sub-discipline C (identified in Table 4.5). For these changes, sub-discipline C members were involved with discussing and developing inquiry-based laboratories. They met on a weekly basis. Isaac, the department chair, is a member of the sub-discipline and took a leadership role in promoting changes to the 300 level laboratories by developing many of the inquiry-based projects.

The exception to the inquiry-based focus to changes in department C is the course taught by Curtis, C201L. C201L is a laboratory course for majors. Two years prior to the change initiative, department C wanted to develop this course to teach students about scientific processes that they may need to know to take part in a faculty member's research group. The course was intended to recruit and train students to do research. Marcus arrived the summer before implementation and worked closely with Curtis to

help implement the change. In this course, students worked on a pilot data for Curtis (the faculty member in charge of the laboratory). The change initiative provided money for laboratory equipment (that was also matched by department C) to make this project possible. Curtis believes this change could not have happened without change initiative resources.

The Concluding Years (Years 3 and 4)

In the concluding years, department C continued to be dedicated to making changes. This dedication to change was indicated by several assistant professors of sub-discipline C joining the 300 level lecture FLC. The department also continued to refine the changes in their laboratory courses and expanded to include C101L in the changes. The goal of the changes to C101L was to use the laboratories that already existed and rewrite them to be more inquiry-based. This change was encouraged by Isaac and completed by laboratory staff, but not necessarily associated with the change initiative. This may indicate that the change initiative was having long-term effect on the way department C taught laboratories. One way that department C continued to refine changes to courses was through TA training. Department C members were concerned that a major challenge to changing to inquiry-based laboratories would be the training of teaching assistants. This was identified early in the project and was addressed in the concluding years by assigning the post-doc (Nancy) to work directly with the TAs in C111L and C112L.

Two change initiative activities were not addressed by department C: assessing the outcomes of changes and sharing successes. Department C intended to have C201L

prepare students for work in faculty research groups, but no formal assessments of the influence of the course on students' involvement in faculty research laboratories have been made. This type of assessment may be the most influential in convincing the members of department C that research projects in the laboratory are successful. Furthermore, the success that was occurring in courses was not being shared with department members. Some members were completely unaware of the changes.

This lack of communication was not due to a lack of discussions about teaching as indicated by the social network (Figure 4.6). In the discussion networks for both the beginning years and concluding years, department C has low modularity (many connections across subgroups) and few subgroups. This may mean that while discussions about teaching are occurring, they are not discussions about adopting new material. The exception would be within the sub-discipline C group that is working together on changes (although these individuals do not form a single subgroup).

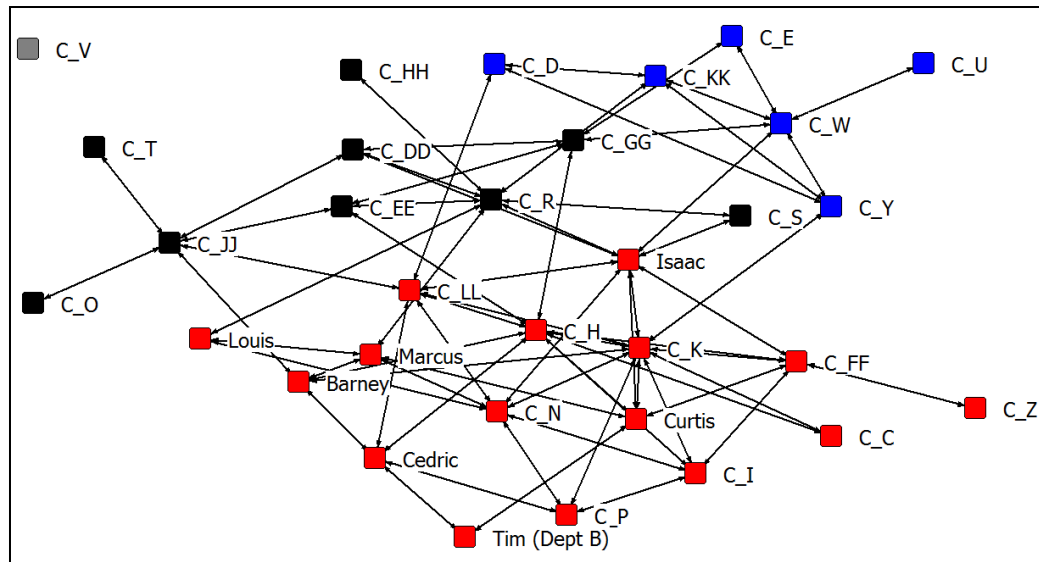


Figure 4.6 The discussion network of department C in the concluding years

Department C and the Eight-Stage Leadership Process

Create vision. In the create vision stage, the guiding coalition is formed to establish a sense of urgency and develop a vision and strategy for implementation. While in other departments, the vision was created by the co-PIs, in department C, the vision has been created by the department members. The department leaders interpreted the goal of the change initiative as creating authentic research experiences. The leaders rejected this goal as too extreme for them to accomplish. Instead, they believed inquiry-based lessons and preparing students for work in undergraduate research for faculty members was the goal of their laboratories. This goal was expressed by Curtis, Isaac, and C_O.

The interpretation by the department C leaders of the goal of the grant was not necessarily correct. The co-PIs generally did agree that inquiry-based laboratories and

smaller projects were a positive change. This indicates that the goals of the change initiative were not completely understood by the members of department C. The department's interpretation of the vision of the co-PIs was in opposition of the vision of the curriculum committee, faculty, and the department chairs.

For the eight-stage leadership process, it is the role of the department chairs to communicate the vision of the co-PIs. However, the chairs rejected the vision of the co-PIs and promoted what they thought was a different vision (although may have been within the co-PIs' vision). The leaders justify this rejection by creating a sense of urgency for their vision based on the need of the department to be concerned about safety in laboratory, they felt authentic research was not possible because it would put students in the laboratory at risk.

Implement change. To implement change, leaders should create and reward short-term wins. In department C, short-term wins were the changes within C201L that were interpreted as successful by Curtis. However, as Curtis explains, he does not think many people know of his success. The department members who are aware of his changes have been impressed. C_K agrees that successes are not being shared; he knows some courses are changing to inquiry-based but he does not know exactly how it is connected to the change initiative.

Leaders should also provide resources and rewards for implementing change. Isaac valued the resource of the post-doc to support change. Also, Curtis used resources to purchase equipment. Isaac and Curtis both valued the FLC connections to provide support and an opportunity to discuss changes.

Institutionalize change. The goal of this step is making changes to the structure of the department to institutionalize the change. In department C, the chair was one of the most involved individuals. He was dedicated to the department's vision to create and implement inquiry-based laboratories. In department C, the inquiry-based changes to the laboratories are expected to continue beyond the conclusion of the change initiative. This institutionalization of inquiry-based laboratories indicates the dedication to change by the chair, the involved faculty, and the laboratory staff. However, the lack of communication to other department members is an indication that the change is not department-wide.

The other change made by department C was the C201L course which focused more on research experiences. This course will continue in the near future, but without future funding it will be difficult to keep up to date. It is unclear if funding will happen in the future.

Department C and Complexity Leadership Theory

Facilitate conditions to create knowledge. Conditions that facilitate change are interactions between individuals, disrupting patterns, simple rules, and non-stifling conditions. The sub-discipline C is the best example of creating conditions to facilitate change in department C. These individuals met weekly to agree on the type of changes that should happen in C301L and C302L. The change initiative's 300 level FLC helped support these connections (because many sub-discipline C members attended meetings). In turn, the FLC helped create conditions that led to changes in C301L and C302L.

Again, these changes were based on the vision that was defined by the department (inquiry-based) rather than influenced by changes in other departments. The individuals valued hearing other people's ideas in the FLC, but looked within the department for new ideas for making change work for them.

While connections within the sub-discipline facilitated change, the department as a whole did not discuss course changes. This is evident from how little department members knew about changes that were happening in courses that were not their responsibility. The connections exist in the social network that could transfer this information, but the discussions did not relate to the changes made in the courses. A missed opportunity for leadership in department C was using these connections to share the ideas that were being designed and implemented in specific courses.

Identify emerging knowledge. To identify emerging ideas, enabling leaders recognize knowledge that should be amplified to the department. As a whole, inquiry-based changes were the goal of the department. This is the knowledge that the chair and the laboratory staff recognized as important for amplifying to the department.

A second type of knowledge identified by the department was the importance of training TAs. This identification began when Cedric considered training TAs in a Co-PI meeting in the first year. Next, the change initiative created the GTALC to train TAs. Finally, Nancy was given the goal of focusing on the TA training of C111L and C112L students. This process represents identifying a challenge and emerging ideas to address the challenge.

Communicate knowledge. Communicating knowledge occurs when enabling leaders share their positive changes with others. Inquiry-based changes started with the 300 level sub-discipline courses. Later, these changes were adopted in C101L, C111L, C112L and influenced Isaac's laboratories that address the non-major 300 level courses. This spread of inquiry-based changes indicates department C's sharing of knowledge about the benefits of inquiry-based courses and how to implement them.

It is possible that communicating knowledge was limited. People who are uninvolved with the specific courses are not aware of the changes that were made. Therefore communication was limited to specific members of the department and not to the entire department. A missed leadership opportunity was using the many connections in department C's discussion network to communicate successful change.

Implement knowledge. Implementing knowledge is directly related to communicating knowledge. Communicating knowledge is sharing what is happening and implementing knowledge is the process of involving the entire group in change. Inquiry-based laboratories are being implemented in several courses of department C. The importance of TA training was shared among the department. This led to a focus on TA training; the next step of change will be sharing the knowledge that is created about TA training with the rest of the department.

Summary of Enacted and Missed Leadership Activities

The summary of the challenges to the process of change and the features of the department that supported change are listed in Table 4.6. According to the eight-stage

leadership process, department C enacted many leadership activities based on their goal of implementing inquiry-based laboratories. This included: (a) creating a guiding coalition that included the department chair (b) identifying a vision that met the needs of the department (c) promoting the vision around safety and time and by matching it to the sense of urgency, and (c) providing resources for the laboratories to implement change (FLC discussions, equipment, and post-doc assistance). Most of the missed leadership activities are based on the lack of communication beyond the laboratories. According to the eight-stage leadership process, the missed leadership activities are (a) communicating with the change initiative about how their vision effects what decisions department C can make, (b) assessing the desired changes, and (c) using assessments to communicate successes to the department to create even more changes.

According to complexity leadership theory, the enacted leadership activities in department C included: (a) using the interactions in sub-discipline C to collaborate on laboratory changes, (b) identifying TA training as emerging knowledge and hiring a post-doc to address these needs (c) communicating the vision of inquiry-based changes. The missed leadership activities according to complexity leadership theory were based on the lack of communication with the rest of the department. These missed leadership activities include: (a) using the FLC interactions to create new knowledge and (b) identifying, communicating, and implementing ideas that emerged besides inquiry and TA training.

Table 4.6 Summary of enacted and missed leadership activities in department C

Eight Stage Leadership Process		
Stage	Enacted Leadership Activities	Missed Leadership Activities
1. Establishing a Sense of Urgency	Create a sense of urgency around the need for undergraduates research assistants	
2. Creating the Guiding Coalition	1.Include the education experts (Cedric) in the guiding coalition 2. Include the department chair in the guiding coalition	
3. Developing a Vision and Strategy	Match the vision to the needs and expectations of the department	
4. Communicating the Change Vision	Align the vision with the sense of urgency (Ex: safety features of inquiry-based lessons and training undergraduate research assistants).	Agree on a vision that fits the goal of the change initiative and the department leaders
5. Empowering Broad-Based Action	1. Provide resources to buy equipment for research activities 2. Provide resources to hire post-docs to assist in change 3.Provide FLC meetings as an opportunity to discuss the change process	
6. Generating Short-Term Wins		Assess changes to share with the department members
7. Consolidating Gains and Producing More Change		Encourage change by department members beyond those involvement in laboratories
8. Anchoring New Approaches in the Culture	Involve the department chair in promoting the transfer of implementation from one instructor to the next	

Table 4.6 – Continued

Complexity Leadership Theory		
1. Disrupting patterns to encourage interactions between individuals		
2. Developing rules that create interdependency to encourage teamwork	Use sub-discipline C's weekly meetings to collaborate on laboratory changes	
3. Encouraging dissenting opinions to increase tension	Provide expertise to create knowledge and enable the development of diversity of opinions through FLCs, post-docs	Be open to new ideas developing in the FLC
4. Avoiding stifling regulation with a simple rule		Provide a simple rule that does not stifle knowledge creation
5. Articulating the vision		Publicly acknowledge individuals who are making changes according to the vision
6. Identifying emerging knowledge from interactions	Identify emerging knowledge among department members (TA training)	
7. Communicating emerging knowledge to formal leadership	Communicate the need for TA training	
8. Implementing knowledge	Hire a post-doc to focus on TA training	

The formal leaders of department C identified implementing inquiry-based laboratories as their goal. Department C members developed inquiry-based laboratories at

the freshman and junior level. However, the change initiative had identified longer five and six week projects and “thinking like a scientist” as the main goal of change. With respect to change initiative goals, department C only changed two courses. By focusing on changing to inquiry-based laboratories, department C may have limited how many department members were involved in change. (The laboratory staff and instructors of laboratories were involved while other department members were not.) The goal of inquiry-based laboratories was too narrow to create department-wide change, but did create changes in many of the laboratories.

Department D

Department D has 45 members. These members include three post-doctoral scholars. Two of these post-doctoral scholars were fully funded by the change initiative. The two change initiative post-docs were members of the department during different years. The change initiative influenced changes in five of the courses that are taught by department D (D202, D202L, D204, D204L, and D301L). Three of these changes were in laboratories; two of these laboratories had associated lectures, which were also changed. The largest changes were in D202, a large (~300 students per section) introductory lecture. In this course, nine instructors were involved in making changes to active learning in their lectures. Table 4.7 provides an overview of the participants of department D.

Table 4.7 Individuals who will be discussed in department D's change narrative and their role in the change initiative

Name	Title	Change Initiative Role(s)
Faith	Chair and Professor	Co-PI, Post-doc advisor, FLC member (Laboratory, D & E, D), Teach D202
David	Professor	FLC member (D & E), FLC facilitator (D), Summer Institute, Teach D202
Nathan	Associate Professor	FLC member (D & E, D), Summer Institute, Teach D202
Mallory	Senior Lecturer	FLC member (Laboratory), Teach D204/D204L
Vivian	Lecturer	Teach D204/D204L
Brad	Assistant Professor	Teach D301L
Anna	Post-Doctoral Scholar	FLC member (all), GTALC, D202/D202L, E201/E201L, D301L
Adele	Post-Doctoral Scholar	FLC member (D), GTALC, D202/D202L
Candace	Laboratory Coordinator	D301L
D_S	Professor	FLC member (D & E, D), Teach D202
D_E	Senior Lecturer	FLC member (D & E, E), Teach E201
D_H	Associate Professor	FLC member (D & E,D), Teach D202
D_CC	Professor and Dean	FLC member (D & E)
D_HH	Professor	FLC member (D & E, D), Teach D202
D_RR	Associate Professor	FLC member (D & E, D), Teach D202
D_WW	Post-Doctoral Scholar	D301L
D_B	Associate Professor	FLC facilitator (D & E)
D_EE	Professor	FLC member (300 level lecture)

Setting the Stage

Department D and department E are closely related. Between the two of them, they have a single undergraduate major. This is why in the first year of the change initiative the D & E FLC targeted members from department D and department E. These were primarily the instructors for the E201 course and the D202 course. Students take these courses in consecutive semesters.

The departments collaboratively staff all of their undergraduate courses; therefore, the chairs also meet frequently. This arrangement is only ten years old. The chairs believe that having this context (that requires communication and coordination between departments) has helped department members become accustomed to change. Furthermore, the chairs explain that the most recent budget has helped identify undergraduate education as an important funding source for both departments.

Prior to the change initiative, department D had undergone some significant changes in instructors. This was especially true for D202. Traditionally, this course had been taught by senior members of department, who had teaching-intensive appointments. However, these seniors members retired and this meant that research-intensive instructors would now be teaching this large-lecture course. The change initiative started at the same time as these departmental changes. Many of the participants from department D became involved in the change initiative because they wanted support in teaching a course for the first time.

The Beginning Years

The introductory lecture course, D202, was the largest change made in the department. This large-lecture course underwent two changes prior to the beginning of the change initiative. First, the retirement of faculty meant instructors that had never taught the course before were now assigned to the course. Second, the new assignments included co-teaching the course with a second faculty member. The motivation for assigning co-teachers included pairing instructors with different types of disciplinary expertise and easing the time commitment of large-lecture instructors. Nine of the ten

faculty assigned to D202 took part in the FLCs (either D & E FLC in the first year, or D FLC in years 2 through 4). In addition to the FLC, two instructors (David and Nathan) attended the summer institute in the beginning of the change initiative. Nathan and David shared the information that they had learned at the summer institute with the FLC. Faith identified their experience as an important source of expert knowledge that could be accessed by FLC members.

The newly assigned instructors in the D202 course felt particularly motivated to develop material in the D & E FLC. In the second year, this FLC split into the D FLC and the E FLC. This was partially due to the frustration of D202 faculty with the lack of productivity of the group.

In the D & E FLC, the new instructors decided that each member would create instructional modules in their area of expertise that included engaging examples and active learning strategies. Then, the instructors would share their modules with one another, so that all of the course lectures had been written to include active learning. Anna (a post-doc) helped to develop the modules and planned the assessments. She found this to be challenging because it required coordinating the teaching strategies of so many faculty. However, the FLC members felt Anna's expertise was important source of support for the change. This included her knowledge of education literature and her work in developing modules.

The chair of department D (D_LL in the first year) attempted to set up a structure within the department of moving individuals in and out of D202. He felt this would lead to a community of individuals who had taught the course and were dedicated to the new

way of teaching the course. D_LL argued that this community would be more successful in creating change than trying to tell faculty members how to teach.

Many of the central individuals in the social network were also working on changes to D202 (Anna, Nathan, David, D_H, D_S, and D_HH) (Figure 4.7). An exception to this is D_CC, a dean that had anticipated a return to teaching, but never was able to teach the course. The frequent discussions of the FLC members in the network provide evidence that D_LL's goal of building a community of individuals within the network through participation in D202 was occurring.

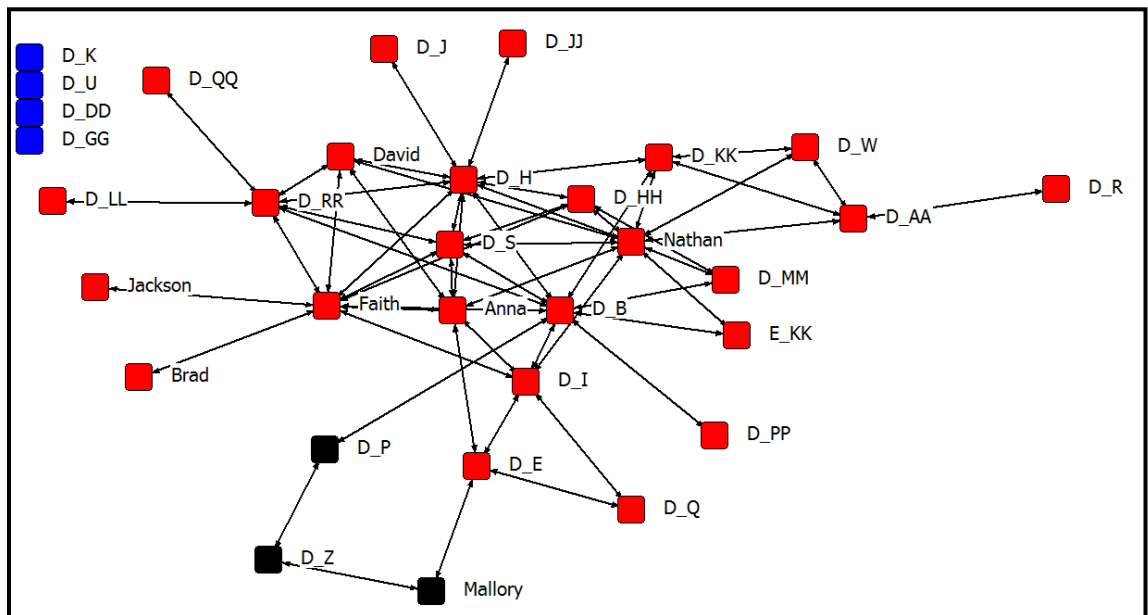


Figure 4.7 Social network of department D in the beginning years

In addition to the major changes in D202, D204L and D301L underwent minor changes in the beginning years. (The final course, D202L, did not become a focus of changes until the concluding years.) According to the leadership of the change initiative,

some resistance to change existed in these courses. Both of the instructors of these courses (Mallory and Candace) felt like their instruction methods were meeting their needs. However, Faith (co-PI) and Jackson (PI) felt that these laboratories could benefit from even more change. More changes took place in these courses during the concluding years.

The Concluding Years (Years 3 and 4)

In the concluding years, the department members continued to focus much of their energy on transforming D202. Adele (a post-doc) was hired to continue the efforts that Anna had started. Changes were also expanded to focus on improving the laboratory courses D202L, D204L, and D301L. D204 never did undergo specific changes, but because it is so closely associated with D204L it is included with those changes. Turnover in instructors continued to be an important catalyst for change. In D202L (the introductory laboratory course), a faculty member retirement allowed Faith to bring in a new faculty member who was encouraged to make changes to inquiry-based lessons. In D301L (an upper level laboratory with over 400 students in twenty sections), Candace left the department and Brad, an assistant professor, was assigned to the course. He continued and expanded upon the authentic research experience that had been added to the laboratory. For D204 and D204L (30 student lecture and laboratory), Mallory went into phased retirement and Vivian was hired to replace her. Vivian was encouraged to make changes in the laboratory with the help of the teaching assistants that had taught the course before. She intends to make changes but was just beginning to work on the course at the end of the fourth year.

One of the major changes to department D was Faith's (a co-PI) appointment as department chair. As department chair, Faith became even more involved in promoting and acknowledging individuals involved in improving instructional practices. She did this by encouraging newer instructors to become involved in the change initiative (Vivian and Brad) and by recognizing teaching efforts in faculty meetings. Members of department D know that Faith values efforts to improve instruction.

Faith continued D_LL's practices of moving instructors in and out of the introductory course. She also believes that this builds community among the department members. She believes that teaching the course helps department members value the effort it takes to teach introductory courses. In the social network in the concluding years (Figure 4.8), the department subgroups are still not well-defined. This could indicate that the community feeling in the department exists. However, an assistant professor (D_W) in the department claimed that support was available for instructors of D202 but not for anyone else. This may mean that department D needs to put more effort into expanding their community to include non-D202 instructors.

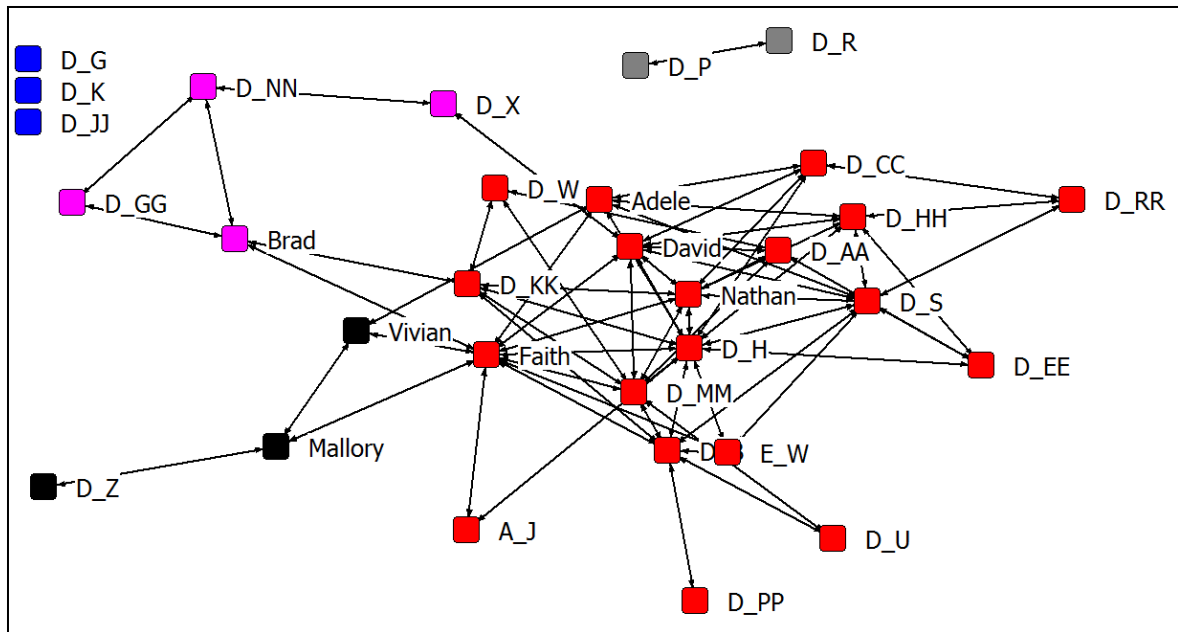


Figure 4.8 Discussion network of department D during the concluding years

A positive change in the department noted by Faith was the number of department presentations that have been on teaching. She said that the department has a history of faculty presenting their research to keep others up to date on their activities and to create opportunities for collaboration. During the change initiative, four people chose to make presentations on teaching activities. In the history of these presentations, Faith says only one other presentation has been on teaching. She believes this is a sign of the changes in the department.

Department D and the Eight-Stage Leadership Process

Create vision. To create vision in the eight-stage leadership process, the guiding coalition develops the vision that meets the needs of the stakeholders of the group and creates a sense of urgency around this vision. In department D, the support of both chairs (D_LL and Faith) in the change initiative's goals was important for the promotion of the vision within the department. Both chairs felt that a vision to encourage quality teaching across all faculty members (not just teaching-intensive faculty) was important. They promoted this vision by encouraging department members to be involved in the change initiative and transferring individuals into the D202 course.

In the eight-stage leadership process, it is important to provide concise and clear description of the vision to members of the department. Neither D_LL nor Faith took this approach. Both chairs felt that it was not possible to tell faculty members what to do. Instead, they took a more indirect approach to promoting vision by discussing positive changes in the faculty meetings and providing support for individuals to attend the summer institute. Faith was more direct about her expectations for change in one on one interaction with faculty, but this meant that many department members were removed from the articulation of the vision. According to the eight-stage leadership process, it would have been more effective for the chairs to promote a specific vision for changes in the department.

Implement vision. To implement vision, the guiding coalition provides rewards and acknowledgements of change. The guiding coalition should create and recognize

short-term wins. The resources in department D were provided through the FLC and the co-teaching assignments. In the FLC, individuals had the opportunity to share ideas and to learn about teaching strategies from experts. The co-teaching arrangement made changing the course possible by dividing the work among nine individuals instead of one. However, D_W did feel that these resources were not made available to the rest of the department.

Faith rewarded individuals who changed their courses by recognizing their efforts in faculty meetings. She also promoted teaching improvements that were not associated with the grant (to promote quality teaching among all members of the department).

Several of the successful implementations were made because new people were assigned to instruct courses. This may indicate that department D had a difficult time finding ways to motivate veteran instructors to change. Changes were not spread throughout the department, but focused on individuals who were newly assigned as instructors in a course.

Institutionalize change. Department D's changes show evidence of institutionalization because in some instances, they have been transferred from the initial adopter to a new instructor. For example, when new faculty members were assigned to teach D202, they adopted an active learning approach. Also, Brad and Vivian chose to continue and expand the changes made in their respective courses. Furthermore, the choice of four individuals to share teaching related presentations at the faculty meetings may provide further evidence of changes in the expectations of behavior in the department. Several new courses benefited from individuals retiring in the concluding

years; it is unclear if these changes will be continued or will change when the courses change instructors again. Faith is committed to convincing the new faculty members to become involved in change.

Department D and Complexity Leadership Theory

Facilitate conditions to create knowledge. In complexity leadership theory, facilitating conditions to create knowledge include disrupting patterns to allow for emerging knowledge, creating interactions between individuals and providing expert knowledge to the individuals involved in these connections, and avoiding stifling conditions through the development of simple rules. The change initiative and the chairs worked together to meet many of these conditions for encouraging change.

First, the chairs disrupted patterns within the department by assigning new instructors to courses. With new instructors in the course, the pattern of continuing what was done in the past was broken. The chairs, especially Faith, motivated these individuals to seek out expert advice to create new patterns of behavior that would be beneficial for students.

Second, the interactions between individuals were encouraged due to the co-teaching assignments and the FLC. The co-teaching assignments required individuals to coordinate with at least one other individual to teach the course. Once this cooperation was required, the FLC was started to encourage interaction outside of partners who were co-teaching together. The ill-defined subgroups in the social network indicate that many interactions are happening across the individuals in department D. The FLC provided a

time and place for these interactions to occur, which strengthened the connections between D202 faculty. Also, the change initiative and the department sent individuals to a summer institute. This summer institute provided these individuals with knowledge that could be shared and used in the FLC to facilitate change.

Third, avoiding stifling conditions occurred through the development of a “simple rule” for individuals to follow. A simple rule provides guide for individuals to identify change that meets the vision of the department as well as freedom to make choices that fit the specific context of the individual. The goal created by D_LL and Faith for the department represents the simple rule because they promoted quality teaching without demanding a specific type of change. They saw their role as promoting and facilitating rather than demanding change. Faith chose to stop attending the FLC when she became chair. She felt this was necessary to allow the faculty members to make decisions about the course without feeling too closely watched by the chair.

Many of the leadership activities of facilitating conditions to create knowledge were enacted in the department. The only way the department could have greatly expanded this part of complexity leadership would have been to involve more individuals in the three conditions that led to knowledge development, as suggested by D_W.

Identify emerging knowledge. In the FLC individuals identified emerging knowledge that could be used to teach D202. The instructors worked together to develop knowledge that could lead to successful change. The post-docs, Anna and Adele, also helped identify emerging knowledge by representing the perspective of the change initiative and the literature of education research to the members of the FLC. This

resource helped the instructors determine what knowledge aligned with the change initiative and literature, and what knowledge may not be as productive in achieving change in D202.

Communicate emerging knowledge. The interactions in the FLC were used by the instructors to share knowledge that they were developing. They shared modules and implementation knowledge to help others make changes in their classroom. Faith was also important for communicating the emerging knowledge to faculty members who had been assigned to the new courses that made changes. She helped Vivian and Brad learn about the changes that the department was making and met with them to discuss how they could also make these changes. Both Vivian and Brad showed some hesitancy. The communication from Faith that this is important and supported by the department helped encourage these changes. Finally, Faith also communicated the emerging knowledge by acknowledging teaching improvement in faculty meetings.

Implement knowledge. Faith has been the most important link for encouraging new faculty to continue changes in courses. She interacts personally with these individuals to encourage change and to connect them with experts within the network. It is unclear if the upper level laboratories will continue to be taught in the new format, however, it is likely the D202 and D202L will continue with the changes.

Summary of Enacted and Missed Leadership Activities

The summary of the challenges to the process of change and the features of the department that supported change are listed in Table 4.8. According to the eight-stage leadership process, department D enacted many leadership activities from all three stages. These included (a) creating a sense of urgency from new course assignments (b) communicating the vision through the FLC (c) providing the FLC and co-teaching as a resource for large-scale change (d) rewarding participation through acknowledgement at faculty meetings and (e) promoting institutionalization by involving new instructors. One of the themes of department D was change due to retirement or replacement of instructors. This may indicate that some leadership activities were missed that could have involved faculty who continued to teach the same courses that they had always taught. According to the eight-stage leadership process, the missed leadership activities are (a) clearly articulating the vision to the department (change was open-ended) (b) including other members of the department beyond those instructors involved in D202, and (c) expanding focus to instructors that had not been recently been assigned to new courses.

According to complexity leadership theory, department D was successful at implementing many leadership activities. A main influence on enacting these activities was the dedication of Faith to the goal of promoting quality teaching. These enacted leadership included: (a) disrupting patterns by assigning new instructors to courses (b) providing expertise to create knowledge through the FLC, post-docs and the summer institute, (c) providing a simple rule that does not stifle knowledge creation, (d) identifying knowledge from multiple sources (FLC, summer institute, post-docs), and (e) communicating new knowledge in interactions of the FLC and faculty meetings.

According to complexity leadership theory, the missed activities only included expanding the enacted activities to include the entire department.

Table 4.8 Summary of enacted and missed leadership activities in department D

Eight Stage Leadership Process		
Stage	Enacted Leadership Activities	Missed Leadership Activities
1. Establishing a Sense of Urgency	Assign new course instructors to create an urgency for course development	
2. Creating the Guiding Coalition	Include the department chair in the guiding coalition	
3. Developing a Vision and Strategy	Create a vision that meets the needs of the department	
4. Communicating the Change Vision		Communicate the vision in concise language
5. Empowering Broad-Based Action	1. Provide resources to hire post-docs to assist in change 2. Assign co-teachers to share in the development of changes 3. Provide funds for attending summer institutes to inspire change 4. Provide FLC meetings as an opportunity to discuss the change process	
6. Generating Short-Term Wins	Recognize early adopters at faculty meetings	
7. Consolidating Gains and Producing More Change	Use retirement and course assignments to promote changes	Encourage current instructors to make changes
8. Anchoring New Approaches in the Culture	Involve the department chair in promoting the transfer of implementation from one instructor to the next	

Table 4.8 – Continued

Complexity Leadership Theory		
1. Disrupting patterns to encourage interactions between individuals	1. Create interactions to encourage knowledge development in an FLC 2. Disrupt patterns by assigning new instructors to courses	
2. Developing rules that create interdependency to encourage teamwork	Assign co-teachers to courses	
3. Encouraging dissenting opinions to increase tension	Provide expertise to create knowledge and enable the development of diversity of opinions through FLCs, post-docs and summer institutes	
4. Avoiding stifling regulation with a simple rule	Provide a simple rule that does not stifle knowledge creation in FLCs	
5. Articulating the vision	Identify individuals whose changes represent the vision in faculty meetings	
6. Identifying emerging knowledge from interactions	Identify knowledge from multiple sources (FLC, summer institute, post-docs)	
7. Communicating emerging knowledge to formal leadership	Communicate new knowledge in interactions of the FLC and faculty meetings.	
8. Implementing knowledge	Use the chair of the department to encourage new instructors to continue changes	Expand changes to more instructors in the department

In department D, the involvement of Faith was important for change. She completed many of the leadership activities that were identified by both change strategies. This includes promoting teaching at faculty meetings and encouraging newly

assigned instructors to make changes to courses. The main challenge facing department D with respect to change was expansion beyond instructors who were newly assigned to courses. To change the rest of the department, the leadership activities need to include and motivate instructors that are not new to a course to become involved in making changes.

Department E

Department E has 45 members. Two of the change initiative post-doctoral scholars were based in department E. A third post-doc, Anna from department D, also worked with department E in the first year of the change initiative. Department E is the only department that did not have a faculty member who was a co-PI or the PI. Most changes occurred in the introductory laboratory course of department E (E201L), but the change initiative also targeted two other courses (E201 and E302). Table 4.9 provides an overview of the change initiative participants from department E.

Table 4.9 Individuals who will be discussed in department E's change narrative and their role in the change initiative

Name	Title	Change Initiative Role(s)
Wade	Assistant Professor	FLC facilitator (D & E, E) FLC member (Lab), Post-doc supervisor, Teach E201, E201L
Paul	Assistant Professor	FLC facilitator (Lab)
Kelly	Post-Doc	GTALC, Develop E201L
Rose	Post-Doc	FLC member (E), GTALC, Integrate E201/E201L, Assess E201L
E_AA	Assistant Professor	FLC member (D & E), Teach E201
E_V	Professor	FLC member (D & E), Teach D202
E_BB	Adjunct Assistant Professor	FLC member (D & E), Teach E201
E_LL	Associate Professor	FLC member (D&E), Teach E201
E_M	Adjunct Associate Professor	FLC member (D & E, D), Teach D202, D202L
E_F	Assistant Professor	FLC member (Lab), summer institute, Teach E302L
Ellen	Laboratory Coordinator	E201L
E_S	Professor and Chair	NA

Setting the Stage

Department E and department D share the same undergraduate major. The departments have a joint committee dedicated to the shared major. In department E, the chair provides time in faculty meetings for this committee to discuss teaching-related issues. This is the primary source of teaching discussions within the department.

In the department, Wade is recognized by many faculty members as being a source of teaching expertise. He is respected by his colleagues for his talent and dedication. Wade's focus on teaching has likely prevented him from having a prominent research program and from promotions beyond associate professor. For this reason, Wade

feels that many of his colleagues are puzzled by his dedication to teaching over research. However, he is motivated to continue to focus on teaching because of the positive results he sees in his students.

In the past, some instructional changes have had a difficult time continuing when faculty members have been reassigned. For example, Paul and E_MM taught a course that had involved inquiry-based laboratories with a longer, open-ended project at the end of the course. However, Paul was assigned to a different course at the beginning of the change initiative and the longer open-ended project did not continue after he changed assignments.

The Beginning Years (Years 1 and 2)

The chair of department E says he is supportive of the change initiative. He trusts the co-PIs and the faculty of the department to make the changes and generally is removed from the details of the effort. He shows his support through offering time at faculty meetings to discuss change initiative activities (although it is unclear if this actually happens, but he is open to the idea) and provides funding support when the budget allows him too. For example, E_F, an assistant professor, attended the summer institute partially through department funds.

E_F's experience at the summer institute led to the changes made in E302L. He attended the summer institute and FLC meetings. He became motivated to introduce a capstone experience into E302L. For this project, students expanded upon a project that they had completed earlier in semester. He also introduced active learning techniques into his lecture courses. After the second year of the change initiative, E_F left the institute.

The other focus of the change initiative in the beginnings years was E201. This is the introductory course that precedes D202. The E201 instructors were involved in the D & E FLC. This FLC's goal was coordination between the semesters and sections of the introductory course.

Wade had spent many years working on the introductory lecture and laboratory courses (E201 and E201L). He was concerned that the change initiative might be focusing on changing for the sake of changing which could cause positive aspects of the course to be lost. However, Wade did not want to be uninvolved with a change initiative that focused directly on these courses. Wade acted as co-facilitator of this FLC along with D_B of department D.

The goal identified by the D & E FLC was the coordination of the efforts in E201 and D202 and the development of shared learning objectives. With respect to E201, Wade felt like the FLC was largely unsuccessful in developing shared learning objectives.

In the second year, the D & E FLC split into two separate FLCs. In department E, the interest in the E FLC was limited. The FLC members felt frustrated by the lack of productivity in the first year and were not willing to dedicate time to a second year of meetings. However, Wade (who remained a co-facilitator) kept all of the instructors on the email list to try to involve them in the information that was being shared in the FLC. As a facilitator of the FLC, Wade shared some of his lectures with his colleagues; however, he is unsure if any members used his resources. In general, he does not feel that his teaching was impacted by what happened in the FLC.

Jackson (PI) believes that part of the reason the E FLC had difficulties was the difference in expectations for the course between himself, the instructors, and Wade. First, Wade felt generally happy with how he taught his course (active learning, engaging). He did not feel that the FLC impacted his teaching nor did he feel that his teaching needed to change. Second, many of the other instructors (but not all) felt that the main focus of the course must be more content-based and not focused on critical thinking (as Jackson thought it should be). Jackson felt that until these goals were reconciled the FLC was not likely to be successful. Finally, the social network of department E in the beginning years (Figure 4.9) had more distinct subgroups than many of the other departments. The subgroup distinction in the discussion network is not surprising given the difference in opinions of instructors of E201. It is likely that members of different subgroups did not have the same opinions on teaching.

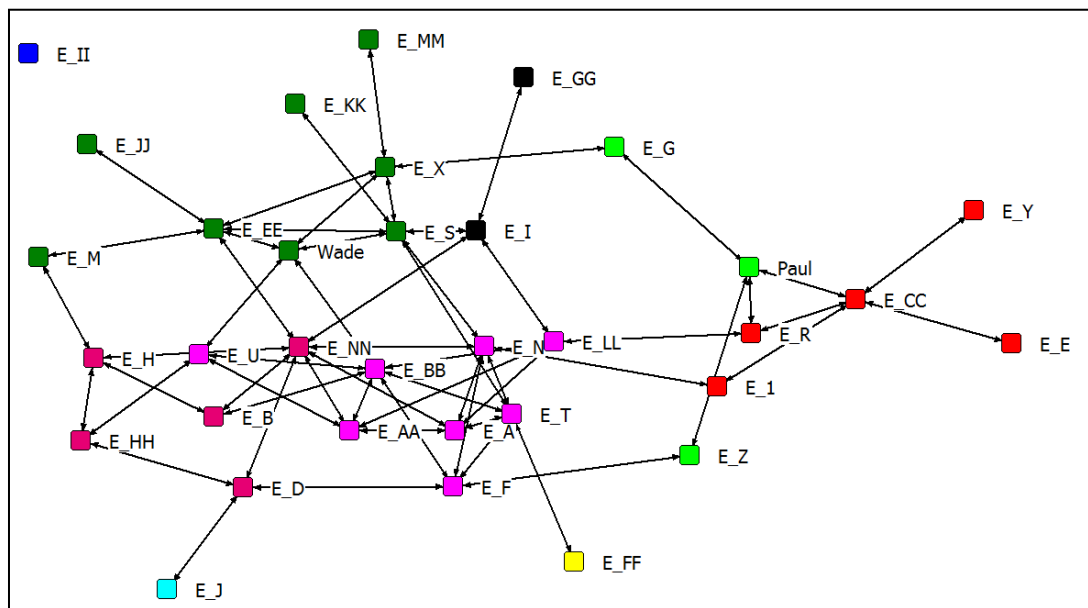


Figure 4.9 Discussion network of department E in the beginning years

The other changes made in department E were E201L, the laboratory associated with the lecture course E201. Wade is the faculty member in charge of the laboratory and he works closely with Ellen, the laboratory coordinator. Wade attended the Laboratory FLC and worked with Ellen and Kelly (post-doc) on changes. In the beginning years, Ellen and Wade expressed concern that inquiry-based projects were considerably different for their science than they were for the other science departments. They felt pressure to make changes that matched what other science departments represented in the Laboratory FLC were doing, even though they also felt that these changes were not appropriate for their discipline. Wade and Ellen have a close working relationship and generally agree on what can and should be done in E201L.

Instead of making the changes suggested by the Laboratory FLC members, Wade identified a particular topic that he felt was essential to understanding his discipline and underrepresented in most introductory courses. He then decided that this topic should be the focus of changes in E201L. When Kelly joined the change initiative, he encouraged her to focus on creating and assessing an inquiry-based project that addressed the topic. Wade felt that he would likely have made these changes without the help of the change initiative, but the initiative gave him extra help by providing support for developing the project and especially for assessing the project. He feels that without the change initiative he would not have had time to assess the project.

The Concluding Years (Years 3 and 4)

The changes in department E during the concluding years focused on E201L and restarting the E FLC to focus on E201. The changes started by E_F were continued by E_OO when she took over E302L.

In E201L (introductory laboratory), two aspects contributed to the ability to change. First, one of the senior faculty members that had worked on the laboratory course retired. This allowed Wade and Ellen to have more freedom to make changes to what was traditionally taught in the laboratory. Second, the department hired individuals to help with the other laboratory courses (other than E201L). This gave Ellen more time to focus on implementing the changes in E201L.

Rose also joined the department as a post-doc in the concluding years. Her goal during the fourth year of change initiative was restarting the E FLC and syncing E201 and E201L. To align the two courses, she attended the lectures and the laboratories. From this attendance, she was able to gain an understanding of the current states of the different sections. She compiled this information into a weekly newsletter that was sent to the instructors and TAs. This newsletter gave a summary of the current state of the sections (topics covered, test dates, laboratory topics, etc.). The newsletter also included some information on active learning techniques that instructors could use. The goal of this newsletter was to facilitate communication between the different sections. The hope was that communication was the first step to aligning the two courses and the sections. Rose felt concerned about how well this would work because she had no formal power to use to influence faculty members to change. At the end of the change initiative, E201 had remained relatively unchanged

Jackson encouraged Rose and Wade to restart the E FLC. Rose felt this was a difficult task because people were frustrated with the E & D FLC's lack of productivity and the E FLC's lack of involvement. However, some new assistant professors who had not been involved before showed interest in restarting the FLC. Wade felt that if the FLC had a more specific goal it could be successful. He suggested that the FLC should focus on choosing a new textbook for E201 (a task that needed to be completed with or without the FLC).

The E FLC was restarted but still had a difficult time producing change. Jackson feels that department E's reliance on Wade for education concerns may be inhibiting their ability to take ownership of education changes. The advice network of department E shows how much the department relies on Wade for his education expertise (Figure 4.10). Many people identify Wade as a successful teacher in the department and the advice networks shows how influential he could be on the teaching practices in the department. However, Wade reports that he is actually only rarely asked for advice about teaching.

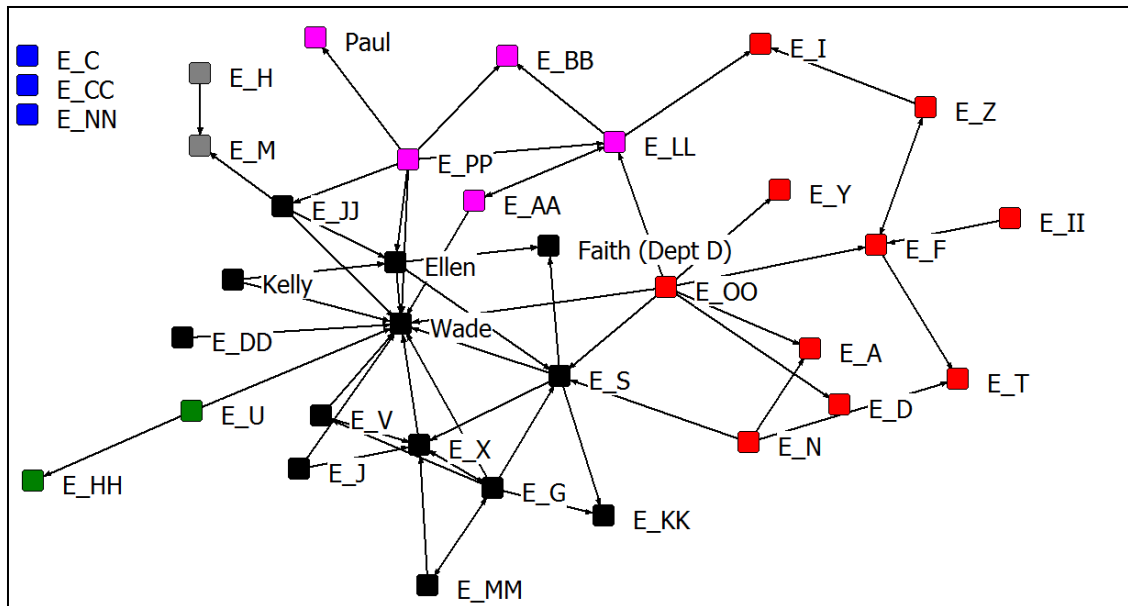


Figure 4.10 Department E advice seeking network in the concluding years

In the concluding years, the social network (Figure 4.11) shows an increase in discussions about teaching. In the beginning years, the individuals who responded to the survey reported talking to an average of 4.6 people. In the concluding years, respondents named an average 6.1 people with whom they discussed teaching. This increase in discussion matches the chair's expectation for what he thought the grant would change in the department. He predicted that conversations would increase and the department would develop an awareness of education concerns. The social networks indicate that the conversations about teaching have increased in department E.

(creating shared learning objectives). They felt that their current practices were meeting their needs and did not feel any urgency for implementing changes.

For E201L, the vision came directly from Wade. He had already identified what he hoped to do with the course before the change initiative arrived. Members of the Laboratory FLC had other ideas about what change should look like in the laboratories. However, both Ellen and Wade felt that these other visions did not fit their needs. This indicates that the change initiative did not create a vision that met the needs of the participants. This led to a disagreement between Wade (the implementer) and the change initiative. This tension may have impacted the extent to which change was made in the department that met the expectations of the change initiative.

Implement change. To implement change, the guiding coalition communicates the vision, provides resources and rewards to encourage change and celebrates short-term wins. The creation of the FLC provided resources for the E201 instructors to become involved in change. It was a place where they could collaborate and spend time on changes. However, the FLC was not successful at motivating change in the classroom. Long discussions on learning objectives did not lead to noticeable changes in the way the course was taught. This might be because the vision of the change initiative was not accepted by the individuals. The change initiative did not match the vision to the perceived needs of the department. According to the eight-stage leadership process, they needed to spend more time establishing a sense of urgency which connected the vision to the perceived needs of the department. It is likely that Wade's vision for change (focusing on a specific topic in E201) was also not accepted by the instructors. Without a

clear sense of urgency and communication of the vision, department E made minimal changes to E201.

The other resource which motivated change in the department was E_F's trip to the summer institute. This resource motivated change in E_F's courses. He was excited about the vision he learned at the summer institute and made changes in his own courses. This resource may have been more important for the change initiative if more people had attended the summer institute, or if E_F was a member of the E FLC to share his experiences.

Institutionalize Change. To institutionalize change, the leadership anchors the change in the culture. The two laboratories that were changed in the department will likely continue. E302L was successfully transferred to the next instructor. E201L will also likely remain the same because the important leaders of the laboratory (Wade and Ellen) will continue the changes. It is unclear if individuals outside of the change initiative will be interested in expanding the changes. However, the increased discussions in the social network do indicate that the teaching-related issue awareness is increasing in the department.

Department E and Complexity Leadership Theory

Facilitate conditions to create knowledge. A leader can facilitate conditions to create knowledge by disrupting patterns, creating interdependency and interactions, creating simple rules, and avoiding stifling conditions. In department E, interactions were

created by involving individuals in the FLC. However, Wade had predetermined ideas about what was important to include in the E201 and E201L courses. These ideas may have created conditions where individuals felt unable to create new knowledge. They may have felt that they could adopt his mode of teaching or not change, but there was no room to develop new knowledge. Furthermore, the patterns of teaching the course were not disrupted. Individuals involved in the E FLC had taught the course before and did not have any pressure to change from disruption of patterns.

Department E is trying to facilitate these conditions with the newsletter created by Rose. This newsletter is increasing communication between sections of the course. Increasing these interactions may be the first step to enabling change in the future.

A missed opportunity in department E was creating interactions with individuals interested in change in the upper level courses. E_F and Paul were interested in change and attended the Laboratory FLC. However, they did not share their experiences within the department. Creating interactions with more individuals in the department could have influenced change beyond the courses that were specifically taught by E_F and Paul.

Identify emerging knowledge. Enabling leaders identify knowledge that is likely to be beneficial for the organization. In department E, knowledge of how to implement inquiry-based projects was developed by Paul and E_F. However, Paul and E_F worked relatively independently of the rest of the department. This did not allow enabling leaders to identify this knowledge because it was not shared with the rest of the department.

In addition, Wade (the authority on education concerns in department E according to the advice network) was not expecting to learn new information from his participation

in the change initiative. He felt that he had all of the knowledge he needed to make changes to his course. Instead, he made his knowledge available to his colleagues and hoped that they would identify what knowledge was useful to them. A missed opportunity may have been recruiting Wade to identify emerging knowledge to share with his social connections.

Communicate emerging knowledge. In this stage, the emerging knowledge is communicated with the formal leadership. Some new knowledge was being used in department D (especially in E201L and E301L); however, enabling leaders had not identified this knowledge as important. The chair was open to allowing individuals from the change initiative to take time in faculty meetings to discuss their changes but this rarely occurred. This process of communicating knowledge was largely absent from the department because no new knowledge had been identified that was important for sharing with the formal leadership.

Implement knowledge. Because the changes were not shared with the formal leadership, the step of implementing knowledge by formal leaders did not occur in department E. Individuals did make changes but these were not the formal leaders of the department.

Summary of Enacted and Missed Leadership Activities

In comparison to other departments, department E made modest changes. However, this is not due to a lack of dedication to education within the department.

These modest changes can likely be attributed to the missed leadership activities according to each change strategy. According to the eight-stage leadership process, department E's enacted leadership activities included: (a) partnering with informal leaders (b) providing resources for an instructor to attend the summer institute and (c) providing post-docs to support change. These enacted leadership activities were not able to create widespread changes in the department. According to the eight-stage leadership process, this is due to the missing leadership activities: (a) establishing a sense of urgency for change in D202, (b) involving the department chair in the guiding coalition, (c) identifying and promoting a vision that meets the needs of the department, (d) sharing the excitement of the summer institution with more members in the department, and (e) recognizing change in faculty meetings.

According to complexity leadership theory, department E took steps towards (a) creating interactions through the FLC, (b) developing rules to create teamwork through the E201 newsletter, and (c) hiring post-docs to assist in change. However, many other leadership activities were missed. These missed leadership included: (a) disrupting patterns to create pressure to change, (b) being open to identifying new knowledge when it was developed, (c) communicating knowledge from the FLC and the summer institute to the department, and (d) implementing changes.

Table 4.10 Summary of enacted and missed leadership activities in department E

Eight Stage Leadership Process		
Stage	Enacted Leadership Activities	Missed Leadership Activities
Establishing a Sense of Urgency		Identify a need for change
Creating the Guiding Coalition	Include education expert and informal leader (Wade) in change	Include the department chair in the guiding coalition
Developing a Vision and Strategy		Match the vision to the needs and expectations of the department
Communicating the Change Vision		Use a departmental FLC to communicate the vision with implementers
Empowering Broad-Based Action	1. Provide resources to hire post-docs to assist in change 2. Provide funds for attending summer institutes to inspire change 3. Provide FLC meetings as an opportunity to discuss the change process	
Generating Short-Term Wins		Recognize early adopters (summer institute experience) at faculty meetings
Consolidating Gains and Producing More Change		
Anchoring New Approaches in the Culture		Involve the department chair in promoting the involvement of instructors
Complexity Leadership Theory		
1. Disrupting patterns to encourage interactions between individuals	Create interactions to encourage knowledge development in an FLC	Disrupt the patterns of current teaching practices to encourage change through FLC meetings
2. Developing rules that create interdependency to encourage teamwork	Create a newsletter to promote teamwork across lecture and laboratory sections	

Table 4.10 -- Continued

3.Encouraging dissenting opinions to increase tension		Enable the development of dissenting opinions through FLCs
4.Avoiding stifling regulation with a simple rule		
5.Articulating the vision		
6. Identifying emerging knowledge from interactions		Identify knowledge from multiple sources (FLC, summer institute, post-docs)
7. Communicating emerging knowledge to formal leadership		Communicate new knowledge in interactions of the FLC and faculty meetings
8. Implementing knowledge	Hire post-docs to support implementation	

Department E had a difficult time accepting the change initiative's vision. This led to Wade and Ellen independently pursuing their changes. Wade and Ellen created changes that impacted a large number of students (all second semester introductory students), but did not impact a large number of instructors. The changes in E302L were inspired by the summer institute and transferred between instructors. However, again these changes did not impact many of the instructors in department E. A main challenge facing department E was a lack of pressure to change. Instructors did not feel that their current approaches to courses were in need of changes. Promoting or creating a shared vision based on the needs of the department was an important aspect of the change process that was missing from department E's narrative of change.

Change Process: Eight-Stage Leadership Process and Complexity Leadership Theory

To address the question, within the context of a higher education change initiative, how is the change process described from the perspectives of two distinct leadership theories, the enacted and missed leadership activities were identified in a case study of departmental change. Table 4.11 provides a summary of these leadership activities. These enacted and missed leadership activities provide insight into how these theories are represented in higher education. The enacted leadership activities are important for providing evidence of how to use these change strategies. The missed leadership activities provide examples of what may have caused change initiatives to only achieve limited change.

Table 4.11 Enacted and missed leadership activities in the five academic departments

Eight Stage Leadership Process		
Stage	Enacted Leadership Activities	Missed Leadership Activities
1. Establishing a Sense of Urgency	1. Promote the change initiative's sense of urgency (scientific thought) through FLC meetings (B) 2. Create a sense of urgency around the need for undergraduates research assistants (C) 3. Assign new course instructors to create an urgency for course development (D)	1. Promote the change initiative's sense of urgency beyond the FLC members (B) 2. Identify a need for change (E)

Table 4.11 -- Continued

2. Creating the Guiding Coalition	<ol style="list-style-type: none"> 1. Include informal leader in the guiding coalition (A) 2. Include education experts in the guiding coalition (B, C) 3. Include the department chair in the guiding coalition (C, D) 4. Include education expert in change (E) 5. Include informal leader in change (E) 	<ol style="list-style-type: none"> 1. Include informal leaders in the guiding coalition (B) 2. Include the department chair in the guiding coalition (B, E)
3. Developing a Vision and Strategy	<ol style="list-style-type: none"> 1. Adopt the vision created by the change initiative Co-PIs (A, B) 2. Match the vision to the needs and expectations of the department (C, D) 	Match the vision to the needs and expectations of the department (E)
4. Communicating the Change Vision	<ol style="list-style-type: none"> 1. Communicate through informal leader's personal connections (A) 2. Use an FLC to communicate the vision with implementers (B) 3. Align the vision with the sense of urgency (Ex: safety features of inquiry-based lessons and training undergraduate research assistants) (C) 	<ol style="list-style-type: none"> 1. Communicate the vision through the formal leaders of the department (A, B) 2. Agree on a vision that fits the goal of the change initiative and the department leaders (C) 3. Communicate the vision in concise language (D) 4. Use a departmental FLC to communicate the vision with implementers (E)
5. Empowering Broad-Based Action	<ol style="list-style-type: none"> 1. Provide resources to buy equipment for research activities (A, B, C) 2. Provide funds for attending summer institutes to inspire change (A, D, E) 3. Provide resources to hire graduate students (B) 4. Provide resources to hire post-docs to assist in change (C, D, E) 5. Provide FLC meetings as an opportunity to discuss the change process (C, D, E) 6. Assign co-teachers to share in the development of changes (D) 	

Table 4.11 -- Continued

6. Generating Short-Term Wins	1. Recognize early adopters in change initiative meetings (B) 2. Recognize early adopters at faculty meetings (D)	1. Assess changes to share with the department members (A, C) 2. Recognize early adopters at faculty meetings (B) 3. Recognize early adopters at faculty meetings (B, E)
7. Consolidating Gains and Producing More Change	Use retirement and course assignments to promote changes (D)	1. Communicate change successes to expand changes within the department (A) 2. Encourage change by department members beyond those involved in laboratories (C) 3. Encourage current instructors to make changes (D)
8. Anchoring New Approaches in the Culture	1. Involve the department chair in promoting the transfer of implementation from one instructor to the next (C, D) 2. Hire the same Teaching Assistants from year to year to transfer course-specific knowledge (B)	1. Involve formal leaders or communicate the need for changes to the formal leaders (A) 2. Involve the department chair in promoting the transfer of implementation from one instructor to the next (B) 3. Involve the department chair in promoting the involvement of instructors (E)
Complexity Leadership Theory		
1. Disrupting patterns to encourage interactions between individuals	1. Create interactions to encourage knowledge development in an FLC (B, D, E) 2. Disrupt patterns by assigning new instructors to courses (D)	1. Involve more individuals in the FLC (B) 2. Disrupt the patterns of current teaching practices to encourage change through FLC meetings (E)

Table 4.11 -- Continued

2. Developing rules that create interdependency to encourage teamwork	<ul style="list-style-type: none"> 1. Use sub-discipline A's weekly meetings that included teaching concerns to share knowledge (A) 2. Use sub-discipline C's weekly meetings to collaborate on laboratory changes (C) 3. Assign co-teachers to courses (D) 4. Create a newsletter to promote teamwork across lecture and laboratory sections (E) 	
3. Encouraging dissenting opinions to increase tension	Provide expertise to create knowledge and enable the development of a diversity of opinions through FLCs, post-docs and summer institutes (A, C, D)	<ul style="list-style-type: none"> 1. Involve more individuals in the FLC who have dissenting opinions about appropriate changes (B) 2. Be open to new ideas developing in the FLC (C) 3. Enable the development of dissenting opinions through FLCs (E)
4. Avoiding stifling regulation with a simple rule	Provide a simple rule that does not stifle knowledge creation in FLCs (B, D)	Provide a simple rule that does not stifle knowledge creation (C)
5. Articulating the vision	<ul style="list-style-type: none"> 1. Provide a simple rule for an FLC to guide development of changes (B) 2. Identify individuals whose changes represent the vision in faculty meetings (D) 	<ul style="list-style-type: none"> 1. Communicate the vision beyond sub-discipline (A) 2. Communicate the vision beyond the FLC members (B) 3. Publicly acknowledge individuals who are making changes according to the vision (C)
6. Identifying emerging knowledge from interactions	<ul style="list-style-type: none"> 1. Identify and support individuals interested in change (Jackson) (A) 2. Identify emerging knowledge in an FLC (TA training) (B) 3. Identify emerging knowledge among department members (TA training) (C) 4. Identify knowledge from multiple sources (FLC, summer institute, post-docs) (D) 	<ul style="list-style-type: none"> 1. Identify possible changes that occurred beyond Jackson's personal connections (A) 2. Identify individuals interested in change beyond the FLC members (B) 3. Identify knowledge from multiple sources (FLC, summer institute, post-docs) (E)

Table 4.11 -- Continued

7. Communicating emerging knowledge to formal leadership	1. Communicate the need for TA training (C) 3. Communicate new knowledge in interactions of the FLC and faculty meetings. (D)	1. Assess knowledge in order to communicate new knowledge with the department(A) 2. Communicate new knowledge at faculty meetings.(B) 3. Communicate new knowledge in interactions of the FLC and faculty meetings (E)
8. Implementing knowledge	1. Use weekly interactions of sub-disciplines to spread knowledge (A) 2. Hire a post-doc to focus on TA training (C) Hire post-docs to support implementation (E) 3. Use the chair of the department to encourage new instructors to continue changes (D)	1. Involve the formal leadership in implementing change (A, B) 2. Expand changes to more instructors in the department (D)

The enacted leadership activities are important for articulating how these two strategies are used in higher education. The enacted leadership activities of the eight-stage leadership are similar to those that were identified during the literature review. This included involving the department chair in the guiding coalition (Diamond, 2005; Fink et al., 2005; Graham, 2012; Morgan and Roberts, 2002) as well as informal leaders (de la Harpe, 2006). In this case study, the participation of the chairs was particularly important for communicating change with the department. This included promoting the vision (inquiry-based laboratories in department C) and recognizing early adopters in faculty meetings (department D). Departments with less support from the chair (A, B, E) found it challenging to communicate changes to the department and to recruit new instructors for

making changes. In the sub-discipline of department A, the chair's role was substituted by weekly meetings among instructors.

Furthermore, as suggested by de la Harpe (2006) and Graham (2012) the co-teaching developed by department D contributed to increased productivity. With ten instructors focused on changing a single course, D202 instructors were able to create modules of active learning for the entire course during one year of FLC meetings.

This case study also identified the importance of matching the vision of the change initiative with the needs of the department (a feature not addressed in the literature). For department C and department E, the change initiative's vision was rejected by some members as not appropriate for their discipline. In department C, this was overcome by choosing a new vision, but in department E, no other vision was identified. This led to individuals acting independently and limited change. When the change initiative is separate from the department, it may be particularly important to promote a vision with a sense of urgency to avoid rejection by department members. More detailed description addressing this and other challenges follows in the next section.

Complexity leadership theory is new to the context of higher education. For complexity leadership theory, encouraging interactions to create new knowledge is important. For participants, these interactions were provided by the FLC. In department D, the FLC was productive because of the disruption in patterns due to retirement and assignment of instructors to new courses. In department E, the FLC was less productive because the instructors did not feel any pressure to change. Within the FLCs, it is important for members to be open to new ideas. In some departments, FLC knowledge

was rejected as not applicable to a particular science. This rejection of new knowledge led to limited change in department E and in the case of department C, to narrowly focused change. Finally, the new knowledge needs to be promoted to the department by the formal leaders (D) or through many interactions among sub-disciplines (A).

Department D disrupted patterns and promoted interaction through co-teaching and assignment to new courses. An important step for complexity leadership theory in higher education will be finding more ways to disrupt patterns to encourage change. As Plowman et al. (2007) suggested, this may be through discussions where the formal leaders encourage dissenting opinions. However, this type of disruption was not found in this case study.

The following section identifies challenges according to the missed leadership activities that were faced by the five departments. Examples of solutions are provided from other departments that addressed the challenge with an enacted leadership activity.

Challenges and Solutions

Every department in the change initiative faced challenges when implementing change. For some departments, these challenges limited the change to one or two courses. In other departments, the enacted leadership activities helped to address these challenges. Change agents who are facing challenges can use the two change strategies and the examples of enacted leadership activities to identify potential solutions to difficulties in the change process. This section of the results addresses the second research question:

How do these descriptions frame problems and solutions associated with change? The goal of these results is to provide change agents with examples of solutions to challenges that may occur in the context of higher education environment-focused change.

To address this question, challenges were first identified in each of the five departments. The themes of the missed and enacted leadership activities were summarized as part of the conclusion of each department's narrative. For example, in department A, the themes of the enacted leadership activities were the importance of Jackson's personal connections and the interactions in sub-discipline A. The themes of the missed leadership activities in department A were a lack of communication beyond these connections and a need for added support from the formal leadership of the department.

Challenges faced by the departments were identified from both the themes of the missed leadership activities (failure to address a problem) as well as the enacted leadership activities (attempt to address a problem). These challenges are summarized in Table 4.12. Although each department faced different contexts and problems, there are four topics that encompass the major issues of the challenges faced by the department. These include: developing a vision that meets the need of the department, motivating individuals to make changes, communicating change with the department members and institutionalizing change. Within these challenge topics, the involvement of the formal leaders of the department often played an important role. However, the appropriate role of the leadership varies according to each strategy. Therefore, the role of the formal leadership is discussed for each topic rather than as a separate topic. Some departments

addressed these challenges with enacted leadership activities. These enacted leadership activities are discussed in each section as potential solutions to challenges.

Table 4.12 Challenges faced by each department

	Develop Vision: Develop a vision that meets the expectations and needs of the members of the department	Motivate: Motivate department members to make changes	Building Momentum: Build momentum by communicating information about change with department members	Institutionalize: Institutionalize change by creating an expectation for change to continue or transferring change from one instructor to another
A	Partially addressed: Informal interactions identify the needs of some individuals but not others	Partially addressed: Some members make changes while others are unaware of the activities of the change initiative	Partially addressed: Sub-discipline has weekly meetings and shares responsibility for changes	Partially addressed: Three courses were transferred to other faculty
B	Not addressed	Partially addressed: A cross-department FLC provides support for interested members to make changes	Not addressed	Partially addressed: One course was transferred to other faculty
C	Addressed: Leaders identify and promote a vision that meets the needs of the department members	Partially addressed: A laboratory-specific vision limits the number of department members that make changes	Partially addressed: Department chair communicates change to laboratory instructors	Addressed: The department chair shared expectations for change to continue with laboratory instructors

Table 4.12 – Continued

D	Partially addressed: The change initiative leaders develop a department-based FLC to create a shared vision	Partially addressed: Department chair disrupts patterns and assigns co-teachers to motivate change	Partially addressed: Use faculty meetings to reward change	Addressed: The department chair encourages changes to be adopted by new instructors
E	Not addressed	Not addressed	Partially addressed: Create a newsletter to describe the current state before change occurs	Partially addressed: One course was transferred to other faculty

The goal of this section is not only to characterize the challenges faced by departments but also to identify leadership activities according to the two change strategies that departments used to address these challenge topics. The key characteristics of change (articulated through the comparison of the change strategies) were used to relate the challenges faced by one department with the enacted leadership activities of other departments. The key characteristics are shown in Table 4.13, which was initially presented earlier in Chapter II.

For example, the first challenge topic is developing a vision. According to the key characteristics, enacted leadership activities that address this challenge would address who creates and promotes the vision, and when it is selected. Each strategy has different ways that this challenge topic could be addressed. For the eight-stage leadership process addressing challenges with the vision would include establishing a sense of urgency to

support the vision. However, for complexity leadership theory, addressing challenges with vision development would include creating more interactions between individuals to develop shared vision.

Table 4.13 Attributes of key characteristics in each change model

Key Characteristics	Eight-Stage Leadership Process		Complexity Leadership Theory	
	Attribute	Stage	Attribute	Item
Vision (New Ideas): Change involves the use of new ideas in the organization.				
Who promotes	The guiding coalition	1-4	Enabling leadership at the high or middle level	4-8
Who creates	Developed by or in consultation with experts (often outside sources).		Emerges via knowledge creation due to interaction between individuals	
When selected	Chosen within the first three steps of the change initiative		Develops throughout the change initiative	
Knowledge: Expertise and knowledge are required for creating change.				
What Kind	In areas of expected outcomes of change	2	In diverse areas related to the organization	1-4
Who	Members of the guiding coalition		In interactions (high, middle or low level individuals)	
When	Present from the beginning		Any time throughout change	6
Decisions: Decisions must be made during the change process.				
Who	Guiding coalition is the decision maker	1-3	Often middle level individuals	6
When	Most decisions made in the beginning		Decisions made throughout the change initiative	

Table 4.12 -- Continued

Employee Roles: Employees of the organization must be involved in the change process.				
High Level Individuals (e.g., Deans, Provosts)	Provide Vision	1-3	Primary role: Formalize good ideas	4,8
Middle Level Individuals (e.g., Department Chairs)	Communicate the vision between guiding coalition and workers	4-7	Primary role: Identify new knowledge to communicate to the formal leadership	7
Low Level Individuals (e.g., Faculty, Staff)	Implement vision	6-8	Contribute new ideas based on unique knowledge, skills or perspectives	1-3
Building Momentum: Successful change involves aligning employees around key ideas.				
Who promotes	Planned by the guiding coalitions	6	Identified by the enabling leadership	5-8
Role in change process	Used to sustain motivation in long-term change		Used to articulate the vision	

The following section characterizes these challenge topics through specific examples from department narratives and provides potential solutions from the enacted leadership activities identified through each change strategy. The first two sections address the most prominent challenges of creating a vision and motivating others to make changes. Next, expanding change through communication to the department is addressed. Finally, institutionalizing change is covered.

For each challenge topic, the challenge is first summarized using descriptions of departments that faced the challenge. Next, examples from other departments are provided to demonstrate how the eight-stage leadership process and complexity

leadership theory could be used to address the challenge. These enacted leadership activities provide examples of how each strategy frames solutions to the challenges.

Challenge Topic One: Creating a Vision that Matches the Needs and Expectations of the Department Members

The first challenge topic is creating a vision that matches the needs and expectations of the department members. This challenge is related to two key characteristics: vision and employee roles. According to the eight-stage leadership process developing a vision involves establishing a sense of urgency. The vision should address the sense of urgency, meet the needs of as many stakeholders as possible, and be promoted by a guiding coalition. Complexity leadership theory promotes vision through identification of a shared vision that emerges from interactions between participants. An enabling leader amplifies knowledge to articulate the vision. The vision is guided by the simple rule of the organization.

This challenge is also related to the key characteristic of “employee roles.” In the eight-stage leadership process, the role of the guiding coalition (high level individuals) is creating a vision from expert knowledge. However, in complexity leadership theory, forming a shared vision is the role of all low level individuals in the organization. Therefore, employee roles will vary for each solution. The role of the change agent will be identifying which solution is appropriate for his or her context.

Examples of Challenges in Developing a Vision

The changes in department B and department A were limited by the challenge of promoting a vision that met the needs and expectations of the department. Department E failed to create a vision, therefore, it could not have the challenge of matching the vision with the expectations of the department. How department E could have motivated change and vision development, which is covered in the second challenge topic.

In department B, the change initiative participants felt that they were the only individuals interested in instructional improvements. However, the social network indicated that the chair and many other individuals were having conversations about teaching and that the change initiative participants' subgroup was not involved in these conversations. In addition, Jackson believes that the chairs (both the former and current chair) were more concerned with the integration of mathematics into courses instead of five or six week inquiry-based or research projects. Therefore, it was not true that the subgroup of participants were the only individuals interested in education. Instead, other members of the department were interested in alternative visions for change. The leaders of the change initiative could have attempted to expand participation in department B by addressing the mismatch of the expectations of the department and that of the change initiative.

In department A, Jackson was successful in matching the vision of the change initiative with the individuals who participated in change. In department A, Jackson used his personal connections to identify individuals who were interested in making changes that fit the vision of the change initiative. He provided resources to these individuals to make the changes. However, it is unclear if Jackson missed other individuals in the

department who would have been interested in change. He also may have missed an opportunity to create shared vision with the department by involving the participants in a departmental FLC (like department D's FLC).

This challenge topic was not as prominent in department A, as it was in department B. Department A (despite this challenge) was successful in creating change in multiple courses. The participants in department A did not report any frustrations with the vision of the change initiative. This indicates that the vision was successfully communicated through the informal interactions of Jackson with the participants of the department. However, these informal interactions did not involve all members the department. A challenge facing department A was developing and communicating a vision that met the needs of these additional individuals.

Eight-Stage Leadership Process Solution to Developing a Vision

Department C faced this challenge and enacted leadership activities to address the challenge. In department C, the leaders felt that research projects were too dangerous and too time-consuming to create to implement in their laboratories. To modify the vision that was promoted by the change initiative to meet their needs, the chairs and members of department C established a sense of urgency to promote the vision of inquiry-based projects. They recognized department C's faculty members desire to have undergraduates become members of their laboratories (sense of urgency). They argued that in order to meet this goal, the vision of inquiry-based projects was necessary. They communicated this vision by arguing that these projects would provide skills that were necessary for working in the laboratories, be safe, and take less time to create than research projects.

By promoting the sense of urgency and vision in the department, the chairs were able to convince several laboratory instructors to make changes to inquiry-based projects. The chairs identified a vision to meet their perceived needs and established a sense of urgency to convince others in the department to follow the vision.

Complexity Leadership Theory Solution to Developing a Vision

In department D, the vision of the change initiative was not interpreted as restrictive. Therefore, it could not be mismatched with the needs of the department. The vision of the change initiative of improving “scientific thought” was used as a simple rule in department D. The change initiative participants were interested in developing a course (D202) that used research-based instructional practices. With respect to D202 lectures, the change initiative’s goal was to encourage students to “think like a scientist.” However, the leaders of the change initiative allowed department D to explore other options for improving their D202 lectures in an FLC specifically dedicated to the course. At the FLC, the instructors interacted with each other and local experts to develop knowledge that met the needs of their course. By allowing the FLCs to be relatively free from mandated direction, the change initiative leadership (including the chair) allowed emerging knowledge to dictate the vision in the department. The FLC members used the simple rule of scientific thought as a guide rather than a directive. This group process of vision development within the FLC ensured that the specific vision of change matched the needs and expectations of the department.

Lessons-Learned: Developing a Vision

The first challenge topic was based on the need of the change initiative to promote a vision that met the needs and expectations of the department. For the eight-stage leadership process, matching the vision with the needs can be done through creating a sense of urgency and aligning the vision with the sense of urgency. If a change agent has identified a change that can meet the needs of the department, promoting this sense of urgency (needs) can align the goals of the department with the goals of the change initiative. However, if the change agent is unsure of what solution will work best for a department, department D's approach of creating an FLC and identifying a shared vision can be used to match the needs of the department with a vision. In this case, the change agent should provide a simple rule to guide the activities of the FLC, but also be open to emerging knowledge from the meetings.

In department B, the change initiative goals were not the same as the department leader's expectation for change, and in department A, the vision was not shared beyond the personal connections of Jackson. These departments could have addressed the challenge with the vision by creating more interactions between the change initiative participants and the department leadership to promote a sense of urgency for change, or the interactions could have been used to develop a shared vision among the participants.

Challenge Topic Two: Motivating Members of the Department to Make Changes

The second challenge topic is motivating members of the department to make changes. This challenge is also related to the key characteristics of vision and employee

roles. For the eight-stage leadership process, motivating others to make changes follows a similar process as the process of matching the vision with the needs of the department. The motivation to change comes from the sense of urgency that is established by the guiding coalition. However, in complexity leadership theory, motivating change comes from disrupting patterns and encouraging teamwork. These conditions lead to change because participants must work together to find solutions to new challenges due to changing patterns and working together.

Example of Challenges to Motivating Change

In department E, an FLC was created to help faculty members implement change. However, this FLC was not successful in producing changes. In fact, in the fourth year, department E was still trying to increase communication between the lecturers and the TAs and had not started making changes in the lecture portion of the course.

The instructors in the lecture course had taught the course in the past. They felt that their approach to the course was successful in meeting their needs and they felt no need to change. Specifically, they believed that the goal of the course should be more focused on content (as it had been in the past) rather than on scientific thought (as suggested by the change initiative). They were not convinced by the co-PIs encouragement that change was necessary in this course. The department members were not motivated to make the changes promoted in the vision of the change initiative.

Eight-Stage Leadership Process Solution to Motivating Change

Department C addressed motivating changes with the same techniques that were used to develop a vision. The leaders of the department identified inquiry-based projects as the type of change that was needed. The department leaders were successful in promoting this vision and in encouraging change. Department C leaders motivated laboratory instructors to make changes in several courses by highlighting the importance of training undergraduates to take part in faculty laboratories.

It is possible that a challenge with motivating change remains in department C. Department C focused exclusively on inquiry-based approaches in laboratories. This means that only instructors involved in laboratories were encouraged to make changes. Many faculty members were not included in the changes that were made. To have an effect on the department environment, the members of department C would need to identify a vision that is inclusive of all instructors.

Complexity Leadership Theory Solution to Motivating Change

Department D addressed the challenge of motivating change by disrupting patterns through new course assignments. This disruption occurred because individuals were retiring from the department. This allowed the chair to assign new instructors to the courses and to encourage their involvement in the change initiative. Furthermore, the chair assigned co-teaching to the introductory courses. Co-teaching promoted teamwork between participants by requiring individuals to work together to develop their section of the course.

Department D's approach to change is considered as a partial solution to this challenge because it does not address motivating individuals who are not assigned to new courses. Further research is needed to understand if different ways of disrupting patterns and creating teamwork can be used for individuals who have not been assigned to co-teach a new course.

Lessons-Learned: Motivating Change

Challenge topic two is closely related to challenge one. It deals with motivating individuals to make changes that are guided by the vision. In the eight-stage leadership process, the enacted leadership activities that provide potential solutions are the same as those used to develop a vision. The formal leadership establishes a sense of urgency and creates a vision to align with this sense of urgency. The department members are motivated to change because of the sense of urgency. On the other hand, complexity leadership theory motivates change by disrupting patterns and promoting teamwork. Department D's patterns were disrupted when new individuals were assigned to co-teach the department's introductory course. It is unclear if there are other ways to disrupt patterns to motivate other department members to make changes. If a change agent does not have the power to disrupt patterns, it may be more important to establish a sense of urgency to motivate change.

In department E, the FLC created to motivate change in the introductory course did not achieve its objective. According to the eight-stage leadership process, the problem was related to the lack of vision development. The members of department E, who wished to motivate change, should have focused on establishing a sense of urgency to

lead to change. However, according to complexity leadership theory, the motivation to make changes should have come from disrupting patterns. This may have been done through assignment of new instructors to the course.

Challenge Topic Three: Build Momentum by Communicating Information about Change with Department Members

Challenge three is sharing information across the department to build momentum. The key characteristic that is related to this topic is building momentum. In the eight-stage leadership process, communication is necessary to promote the vision by creating and rewarding short-term wins. The goal of these leadership activities is encouraging even more people to be involved in change. For complexity leadership theory, building momentum and communication is used to promote interactions to create new knowledge.

Examples of Challenges in Building Momentum

Subgroups of department members in department A, B, and C were involved in change, but large numbers of department members remained unaware of change efforts in their departments. These subgroups included: sub-discipline A in department A, the change initiative participants in department B, and the laboratory instructors in department C. Without communication to the rest of the departments about what change occurred, the change agents will be unable to build momentum to create more changes across the department.

Eight-Stage Leadership Solution to Building Momentum

In department D, the attempt to communicate changes and build momentum in the department was made by Faith (a co-PI and the department chair). She made an effort to mention education achievement in the faculty meetings. This acted as a reward for making changes. The goal of this leadership activity is encouraging more instructors to make changes because they also want to be rewarded through acknowledgement in faculty meetings. In order to build momentum, the chair should be involved in the guiding coalition. This provides access to faculty meetings to share successes with the department and build momentum for even more changes. It is possible that department D could continue to build momentum by making rewards more substantial. This could include formal awards from the department.

Complexity Leadership Theory Solution to Building Momentum

In department A, a partial solution exists within sub-discipline A. The members of sub-discipline A have an expectation of collaborating on course designs. These expectations for collaboration combined with the weekly meetings have led to the sharing of information among the members of sub-discipline A. This interaction builds momentum by creating more knowledge to promote further changes. Different individuals have access to varying knowledge and expertise. When more individuals become aware of the changes in the department, this increases the diversity in knowledge that is available to solve challenges and further change. The interactions in sub-discipline A are only a partial solution because many members of department A that are outside of

sub-discipline A were not involved in these interactions. Therefore, they were unaware of changes and could not contribute to knowledge development.

It could be argued that department E also partially addressed communication through the development of a newsletter. This newsletter was shared with instructors in the lecture and laboratory courses. The newsletter was expected to increase communication and develop a shared understanding of how the course was currently taught in order to lead to coordination in future changes. Because this newsletter was started near the end of the change initiative, it is unclear if this activity achieved its intended purpose.

Lessons-Learned: Building Momentum

Momentum is built in change initiatives through communication. For the eight-stage leadership process this means rewarding changes through acknowledgement at faculty meetings. For complexity leadership theory, interactions between department members can be used to create more knowledge to build momentum for future changes. A challenge with using interactions to build momentum is creating interactions beyond subgroups of the department.

For the departments that only had a subgroup of individuals involved in change, it will be important to increase communication with the rest of the department to build momentum. If the department chair is supportive of change, this can be done through rewarding instructors for making changes through acknowledgement at faculty meetings. However, if the chair is not involved, momentum can still be built through communicating information about change in informal interactions. This will increase the

number of people who can contribute to developing new knowledge and creating even more change.

Challenge Topic Four: Institutionalize Change by Creating an Expectation for Change to Continue or Transferring Change from One Instructor to Another

Challenge three is institutionalizing change. The key characteristic related to this challenge topic is employee roles. There are two important roles for institutionalizing change: the role of middle level individuals to communicate change and the role of high-level individuals to formally institutionalize change. In the eight-stage leadership process it is the role of middle level individuals (often department chairs) to communicate the vision to the low level individuals (department members). In complexity leadership theory, institutionalizing change occurs when enabling leaders (often middle level individuals) communicate new knowledge to formal leaders (department chairs), and the formal leaders implement change.

Examples of Challenges in Institutionalizing Change

In all five departments, few changes were made to the formal structures of the departments. Therefore, other indicators of institutionalizing change were identified. This included: transfer of course changes from an initial adopter to a new instructor and department members expectations of continuity of course changes in the future. If a single instructor had developed and continued to teach the course (department E and B), it was difficult to determine if change had been institutionalized.

An important aspect of institutionalizing change is communication of change with the formal leaders (to inform them what changes to institutionalize and to enable them promote changes to individuals). Departments A, B, and E had difficulty with communication of changes to the formal leader. In department A, participants worked independently on changes. The changes were not communicated to the department chair. Without communicating changes with the formal leader, the changes could not be institutionalized in the department. In department B, the change initiative participants were members of a social subgroup that was not connected to the chair. Communication of the participants' changes did not reach the rest of the department, partly because of their social distance from the formal power in the department. In department E, the instructors were trying to increase communication through a newsletter, however, this communication only started at the end of the change initiative.

Eight-Stage Leadership Process Solution to Institutionalizing Change

In department C, the involvement of the chair helped facilitate communication of the vision. The chair spoke frequently with the laboratory staff about implementing inquiry-based teaching. The formal leader's involvement ensured that they would be knowledgeable of the change that was happening. In department C, many of the laboratories have changed and also appear to be considered long-term changes by the chairs and the laboratory instructors. On the other hand, this communication did not include department members who were not involved in the laboratories. Communication to other department members was not a concern of the chair and may need to be encouraged by the change initiative to expand changes beyond laboratory courses.

Complexity Leadership Theory Solution to Institutionalizing Change

In department D, Faith (the chair) was involved in change. She communicated what changes have been occurring in the department at faculty meetings. Faith was dedicated to communicating successes to provide rewards for focusing on instructional concerns. This helped create an expectation for change; Faith institutionalized change by encouraging new instructors to continue to develop the courses that they were adopting.

Lessons-Learned: Institutionalizing Change

For both the eight-stage leadership process and complexity leadership theory, institutionalizing change is the role of the formal leader. In the eight-stage leadership process, the chair formalizes changes that helps achieve the vision. In complexity leadership theory, the formal leader amplifies emerging knowledge to the department to articulate the vision. In order for either of these changes to take place, the changes must be communicated with the chair or the chair must be involved in change. For both departments that had solutions for communication, the chair was involved directly in change. Further research should investigate if communication with the chair requires the direct involvement of the chair or if it can occur successfully without chair being involved in changes. For department's where the chair was not involved (A, B, E) institutionalizing change may not be a realistic expectation of the change initiative.

Summary of Challenges and Solutions

The goal of this section has been to address the second research question: How do these department descriptions frame problems and solutions associated with change? In

this section, challenges that faced the five departments were summarized into topics. These topics included: vision, motivation, momentum, and institutionalization. Each topic was associated with one or more key characteristics to identify leadership activities that may be used to address challenges. Solutions to challenges were provided from the department examples. A summary of these results is in Table 4.14. The role of the change agent will be identifying solutions that are appropriate for use in a particular change initiative. To assist this process, an area of future research will be identifying how context-specific these solutions are, and expand upon their suggestions for specific activities that can lead to change in higher education.

Table 4.14 Challenges in the process of change and examples of potential solutions

Challenge	Change Strategy	Enacted Leadership Activities
Develop vision: Develop a vision that meets the expectations and needs of the members of the department	Eight-stage leadership process	Involve the department chair to establish a sense of urgency around the need for the proposed changes.
	Complexity leadership theory	Develop a shared vision by involving department members who are engaged in change in discussions of future development of the department.
Motivate: Motivate department members to make changes	Eight-stage leadership process	Articulate why change is needed to address the threat identified in the sense of urgency.
	Complexity leadership theory	Disrupt current practices by reassigning teaching responsibilities. Encourage new instructors to seek advice when designing new courses.
Build Momentum: Build momentum by communicating information about change with department members	Eight-stage leadership process	As a member of the guiding coalition, the department chair shares information about change in faculty meetings and formal gatherings.
	Complexity leadership theory	Faculty members are expected to share responsibilities for the courses offered by the department. This encourages collaboration on change efforts and the sharing of information about courses
Institutionalize: Institutionalize change by creating an expectation for change to continue or transferring change from one instructor to another	Eight-stage leadership process	Involving the chair in encouraging the expansion of changes beyond the originally targeted environments
	Complexity leadership theory	The chair encourages new instructors to join groups that have developed change

CHAPTER V

CONCLUSIONS AND IMPLICATIONS

Conclusions

In academic departments, both emergent and prescribed change strategies have been successful at creating instructional change (e.g. Gibbs et al., 2009). These changes, and more, are necessary for addressing the many calls for improving undergraduate STEM education (e.g. Kardash & Wallace, 2001; Seymour & Hewitt, 1997). The goal of this study has been to identify how the process of change is described from the perspective of two distinct change strategies, and how these strategies frame problems and solutions. The eight-stage leadership process represented prescribed environment-focused change strategies and complexity leadership theory represented emergent environment-focused change strategies. This study involved five STEM departments operating within a multi-department change initiative at a large research university.

The first guiding research question asked: Within the context of a higher education change initiative, how is the change process described from the perspectives of two distinct leadership theories? This question was answered by identifying enacted and missed leadership activities that occurred in a case study of change in higher education. The description of change through the perspective of the eight-stage leadership process identified higher education features that were important for change. These include involving department chairs in the guiding coalition, providing resources to buy equipment for implementing change and creating faculty learning communities (FLCs) to

promote the change initiative vision. According to complexity leadership theory, it is important to increase interactions through FLCs and to disrupt patterns by assigning co-teaching responsibilities.

The second research question asked: How do these descriptions frame problems and solutions associated with change? The problems identified by the two distinct change strategies were identified by looking for themes in the missed and enacted leadership activities. In the missed leadership activities, the problems were challenges that the change initiative failed to address. In the enacted leadership activities problems were identified as challenges that were successfully or partially addressed. The types of challenges faced by the five departments were:

1. *Develop a vision* that meets the expectations and needs of the members of the department
2. *Motivate* department members to make changes
3. *Build momentum* by communicating information about change with department members
4. *Institutionalize* change by creating an expectation for change to continue or transferring change from one instructor to another

The types of challenges were related to the key characteristics of change to identify examples from the case studies of how departments had attempted to address each challenge from the perspective of each change strategy. The eight-stage leadership process's and complexity leadership theory's perspective on solutions to challenge topics provides change agents with more than one example of methods to address challenges. For example, the eight-stage leadership process's solution to the first category of

developing a vision included establishing a sense of urgency that met a perceived need of department members. In department C, the sense of urgency established by the department leaders was the need to train undergraduate researchers to work in faculty research groups. To address the need for undergraduate researchers, the department leaders promoted instructional change to inquiry-based laboratories. Because the department members recognized the need for this change, they were willing to make changes to inquiry-based laboratories. The complexity leadership example of a solution to this challenge topic was creating interactions to develop a shared vision. This was achieved in department D through the creation of a faculty learning community. This learning community developed the vision for the introductory lecture course in department D. Because all of the instructors were members of the faculty learning community, they were all a part of choosing and moving towards the agreed upon instructional changes.

Many of the departments had difficulty institutionalizing change. For both the eight-stage leadership process and complexity leadership theory the formal leadership plays an important role in institutionalizing change. In the eight-stage leadership process, the formal leadership should promote changes by compelling more instructors to make the prescribed changes (e.g. department C). On the other hand, complexity leadership theory promotes changes by encouraging new instructors to join the interactions that are likely to lead to the changes in the department (e.g. department D). However, in departments that did not have the support of the formal leadership, the changes were not institutionalized.

These descriptions of the change process in departments, as well as the four challenge topics and solutions provide examples of the features of the two change strategies in higher education. It will be important for future research to address the extent to which the success of leadership activities is context specific and to identify a wider variety of leadership activities that change agents can use to address challenges to change. The following section provides guidance to change agents in higher education when designing change initiatives and choosing modifications during implementation according to the findings of this study.

Implications

This study provides an example of conceptualizing change through two distinct change strategies. The key characteristics (vision, knowledge, decisions, employee roles, and building momentum) identify aspects of change that are articulated differently by each strategy. Conceptualizing change strategies is important for both instructional change researchers and change agents. For researchers, the description of change and the key characteristics can be used to inform analysis of other change initiatives in higher education. For change agents, the examples of enacted leadership activities and an articulation of the characteristics of change can inform the design of change initiatives and adjustments to the design of change initiatives during implementation to address challenges.

Researchers of Higher Education Instructional Change

Researchers of change in higher education can build upon the descriptions of enacted and missed leadership activities with future studies of change in higher education. Little research is available to understand how environment-focused change can influence instructional practices in higher education. The enacted and missed leadership activities identified in this study may be common activities in other change initiatives or they may have been unique to the change initiative of this study. By analyzing other change initiatives, researchers can determine if certain activities (or challenges) are common to change initiatives in higher education. If this is the case, then researchers can work to identify methods for maximizing the results of enacted leadership activities.

This study found characteristics of both change strategies in a single change initiative. Department C provided an example of using prescribed vision creation by establishing a sense of urgency that addresses a perceived need in the department. In department C, the chairs identified the need for undergraduate researchers that was shared by faculty members in the department. This provided the catalyst for change needed to motivate individuals in the department to make the changes. For complexity leadership theory, vision development by department members was used in department D through creation of an FLC. The participants provided knowledge and made decisions that defined the vision of change for that department. As Gibbs et al. (2009) found, sometimes change in higher education is based on a mixture emergent and prescribed change. The key characteristics identify attributes that researchers can use to differentiate between the types of change that is occurring. In the future, this differentiation may

determine which key characteristics the context of higher education seems to favor, or if activities vary considerably according to the change initiative context.

Change Agents in Higher Education

Change agents can use the results of this study to design change initiatives and to assess the purpose of activities within the change initiative. The attributes of the key characteristics help a change agent understand the purpose of the characteristics according to each change strategy. The results of this study provide a detailed description of how leadership activities can be represented in higher education. With knowledge of the distinct strategies and examples of their implementation, change agents can design a change initiative and identify potential solutions for challenges faced during the change initiative.

First, change agents can use this study to inform the design of change initiatives. Decisions in the change initiative design will influence the expectations for the responsibilities of the participants. Each change initiative should address the key characteristics of change. The change agent can choose within each characteristic which strategy is better suited for their environment by identifying the purpose and attributes that meet the initiative's needs.

For example, knowledge is a key characteristic of change. The characteristic's attributes identify what kind of knowledge is needed, who provides it and when it is needed according to each change strategy. In the eight-stage leadership process, the new knowledge needs to be included within the guiding coalition or obtained from outside sources at the beginning of the change initiative. In this case study, an example of the

eight-stage leadership process approach to knowledge in change was the Laboratory FLC. The Laboratory FLC was interested in obtaining expert knowledge from external individuals. They invited experts to speak to the FLC and identified models for change that would work for their environment. However, some departments (especially department E) felt that this external expert knowledge was not applicable to their situation. They felt that they needed to create new knowledge to address their changes. In department E's changes to the introductory course, knowledge was approached through leadership activities that represent complexity leadership theory. The introductory laboratory course (E201L) was changed by relying on Wade and Ellen to develop new knowledge. This knowledge was created throughout the change process by the teamwork of Wade, Ellen, and the post-docs of department E. This represents a complexity leadership theory approach to knowledge development, by creating connections between individuals in the environment to lead to change instead of using outside experts. When designing a change initiative, the change agent can consider if expert knowledge is likely to be accepted by the participants in their change initiative, or if the participants would prefer to develop the knowledge that they implement. Analyzing this contextual feature helps the change agent determine which type of activities to plan. In the same manner, the remaining key characteristics can help a change agent consider how to address different aspects of change.

Second, a change agent can associate each design feature with a key characteristic to provide support for including the feature and to articulate the expectation for that activity in the change process. This expectation for the function of the feature in change can be used to assess if the change initiative feature is meeting the needs of the key

characteristic. Furthermore, the challenge topics (vision, motivation, communication and institutionalization) can help a change agent assess a change initiative by drawing his attention to specific topics and suggesting potential solutions.

If a feature of the change initiative is not meeting the expectations of the design, the change agent can identify solutions according to each change strategy to address the challenge. If these challenges fit within the topics that were identified in this case study, the change agent can use the solutions identified in Chapter IV to address the challenge. If the challenge is one that has not been previously identified, the change agent can look for potential solutions by considering the key characteristic that should have been addressed by the change initiative feature. This will identify two different perspectives for analyzing the challenge. With two strategies, the change agent can choose a solution that is best fitted to the context of their change initiative. The change agent should share their identification of solutions with other change agents to continue to add to the knowledge of how to design and implement change in higher education.

Closing

Improving the design of change initiatives addresses a critical problem within STEM higher education. This case study provides detailed descriptions of the change process from the perspective of two environment-focused change strategies. The key characteristics of the change strategies focus change agent attention on important aspects to address with change initiative activities. The challenges faced by change initiatives can be articulated by relating each challenge to key characteristics. This helps the change agents identify potential solutions from each of the change strategies. Results of this

study provided examples of how challenges identified in department narratives have been addressed with enacted leadership activities in other departments. Change agents can use these results to select leadership activities that have the potential to address the challenges within the context of their change initiative

REFERENCES

- Abenga, E. (2009). Capacity building in higher education: The case of Masinde Muliro University of Science and Technology, Kenya. In *Proceedings of the International UNISTAFF Forum* (pp. 277–286).
- Association of American Universities (AAU). (2011). Undergraduate STEM initiative, from <http://www.aau.edu/policy/article.aspx?id=12588>
- Avolio, B. J., Walumbwa, F. O., & Weber, T. J. (2009). Leadership: current theories, research, and future directions. *Annual Review of Psychology*, 60(1), 421–449. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/18651820>
- Barth, M. (2013). Many roads lead to sustainability: a process-oriented analysis of change in higher education. *International Journal of Sustainability in Higher Education*, 14(2), 160-175.
- Birnbaum, R. (2000). The life cycle of academic management fads. *Journal of Higher Education*, 71(1), 1-16
- Borgatti, S. P. (2002). *Netdraw Network Visualization*. Harvard, MA: Analytic Technologies.
- Borgatti, S. P., Everett, M. G., & Freeman, L. C. (2002). *Ucinet for Windows: Software for social network analysis*. Harvard, MA: Analytic Technologies.
- Brainard, J. (2007). The tough road to better science teaching. *Chronicle of Higher Education*, 53(48), A16.
- Brigham, S. E. (1996). Large-scale events: new ways of working across the organization. *Change: The Magazine of Higher Learning*, 28(6), 28-37.
- Burnes, B. (1996). No such thing as... a “one best way” to manage organizational change. *Management Decision*, 34(10), 11-18.
- Carley, K. M. & Ren, Y. (2001). "Tradeoffs between performance and adaptability for C3I architectures." In Proceedings of the 2001 Command and Control Research and Technology Symposium, Annapolis, Maryland, June, 2001.
- Christakis, N. A., & Fowler, J. H. (2009). *Connected: The surprising power of our social networks and how they shape our lives*. New York: Little, Brown and Company.

- Corbin, J., & Strauss, A. (Eds.). (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage.
- Cummings, T. G., & Worley, C. G. (2009). *Organization development and change*. Cengage Learning.
- Daempfle, P. A. (2003). An analysis of the high attrition rates among first year college science, math, and engineering majors. *Journal of College Student Retention: Research, Theory and Practice*, 5(1), 37–52.
- DeHaan, R. L. (2005). The impending revolution in undergraduate science education. *Journal of Science Education and Technology*, 14(2), 253–269.
- de la Harpe, B. (2006). Lessons learned from three projects to design learning environments that support 'generic' skill development. *Journal of Learning Design*, 1(2), 21–34.
- de la Harpe, B., & Thomas, I. (2009). Curriculum Change in Universities Conditions that Facilitate Education for Sustainable Development. *Journal of Education for Sustainable Development*, 3(1), 75-85.
- Diamond, R. M. (2005). The institutional change agency: The expanding role of academic support centers. *To improve the academy*, 23, 24-37.
- Eckel, P. D., & Kezar, A. J. (2003). *Taking the reins: Institutional transformation in higher education*. Greenwood Publishing Group.
- Edwards, R. (1999). The academic department: How does it fit into the university reform agenda? *Change: The Magazine of Higher Learning*, 31(5), 16-27.
- Elton, L. (2003). Dissemination of innovations in higher education: A change theory approach. *Tertiary Education & Management*, 9(3), 199-214.
- Fink, L. D., Ambrose, S., & Wheeler, D. (2005). Becoming a professional engineering educator: A new role for a new era. *Journal of Engineering Education*, 94(1), 185-194.
- Foertsch, J., Millar, S. B., Squire, L., & Gunter, R. (1997). Persuading professors: A study of the dissemination of educational reform in research institutions. *University of Wisconsin–Madison, LEAD Center, Madison*.
- French, W. L., & Bell, C. H. (1973). *Organization development: Behavioral science interventions for organization improvement*. Englewood Cliffs, NJ: Prentice-Hall.

- Froyd, J. (2008). White paper on promising practices in undergraduate STEM education. National Academies.
http://sites.nationalacademies.org/dbasse/bose/dbasse_080106 Accessed 27 June 2013.
- Froyd, J., Penberthy, D., & Watson, K. (2000). Good educational experiments are not necessarily good change processes. In *Frontiers in Education Conference, 2000. FIE 2000. 30th Annual* (Vol. 1, pp. F1G-1). IEEE.
- Gibbs, G., Knapper, C., & Piccinin, S. (2008). Disciplinary and contextually appropriate approaches to leadership of teaching in research-intensive academic departments in higher education. *Higher Education Quarterly*, 62 (4), 416-436.
- Gibbs, G., Knapper, C., & Picinnin, S. (2009). *Departmental leadership for quality teaching - an international comparative study of effective practice*. London, UK: Leadership Foundation for Higher Education.
- Google Scholar. (2014). About Google Scholar, from <http://scholar.google.com/intl/en-US/scholar/about.html>.
- Graham, R. (2012). Achieving excellence in engineering education: the ingredients of successful change. *The Royal Academy of Engineering*, 3.
- Hanson, W. R., & Ford, R. (2010). Complexity leadership in healthcare: leader network awareness. *Procedia-Social and Behavioral Sciences*, 2(4), 6587-6596.
- Hativa, N. (1995). The department-wide approach to improving faculty instruction in higher education: A qualitative evaluation. *Research in Higher Education*, 36(4), 377-413.
- Henderson, C., Beach, A., & Finkelstein, N. (2011). Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature. *Journal of Research in Science Teaching*, 48(8), 952-984.
- Henderson, C., Dancy, M., & Niewiadomska-Bugaj, M. (2012). The use of research-based instructional strategies in introductory physics: Where do faculty leave the innovation-decision process? *Physical Review Special Topics - Physics Education Research*, 8 (2), 020104.
- Hurtado, S., Eagan, K., & Chang, M. (2010). Degrees of success: Bachelor's degree completion rates among initial stem majors. *Higher Education Research Institute at UCLA, January*.

- Kardash, C. M., & Wallace, M. L. (2001). The perceptions of science classes survey: What undergraduate science reform efforts really need to address. *Journal of Educational Psychology*, 93(1), 199–210.
- Kezar, A. (2011). What is the best way to achieve broader reach of improved practices in higher education? *Innovative Higher Education*, 5(2), 235-247.
- Kotter, J. P. (1995). Leading change: Why transformation efforts fail. *Harvard business review*, 73(2), 59-67.
- Kotter, J. P. (1996). *Leading change*. Harvard Business Press.
- Kressel, K., Bailey, J. R., & Forman, S. G. (1999). Lessons from a university faculty development. *Journal of Educational and Psychological Consultation*, 10(1), 51–82.
- Lewin, K. (1947). Group decision and social change. *Readings in social psychology*, 3, 197-211.
- Mervis, J. (2013). Transformation is possible if a university really cares. *Science*, 340, 292–296.
- Morgan, C., & Roberts, D. (2002). Herding cats? Obtaining staff support for curriculum change and implementation. *Spheres of influence: Ventures and visions in educational development. Australia: The University of Western Australia*.
- National Research Council. (2012). Discipline-based educational research: Understanding and improving learning in undergraduate science and engineering. Washington, DC: National Academies Press.
- Newman, M., & Girvan, M. (2004). Finding and evaluating community structure in networks. *Physical Review*, 69 (2), 1-15.
- Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company*.
- O'Brien, K., Reams, J., Caspari, A., Dugmore, A., Faghihimani, M., Fazey, I., ... Winiwarter, V. (2013). You say you want a revolution? Transforming education and capacity building in response to global change. *Environmental Science & Policy*, 28, 48–59.
- Plowman, D. A., Solansky, S., Beck, T. E., Baker, L., Kulkarni, M., & Travis, D. V. (2007). The role of leadership in emergent, self-organization. *The Leadership Quarterly*, 18(4), 341-356.

- Pollock, S., & Finkelstein, N. (2008). Sustaining educational reforms in introductory physics. *Physical Review Special Topics - Physics Education Research*, 4(1), 010110.
- Prell, C. (2012). *Social network analysis: History, theory, & methodology*. Thousand Oaks, CA: Sage Publications.
- Prince, M. J., & Felder, R. M. (2006). Inductive teaching and learning methods: Definitions, comparisons, and research bases. *Journal of Engineering Education*, 95(2), 123-128.
- NVivo qualitative data analysis software. (2012) QSR International Pty Ltd. Version 10.
- Quinn, D., Amer, Y., Lonie, A., Blackmore, K., Thompson, L., & Pettigrove, M. (2012). Leading change: Applying change management approaches to engage students in blended learning. *Australasian Journal of Educational Technology*, 28(1), 16-29.
- Schreiber, C., & Carley, K. M. (2008). Network Leadership: Leading for Learning and Adaptability. In M. Uhl-Bien & R. Marion (Eds.), *Complexity Leadership, Part 1: Conceptual Foundations* (pp. 291–331). Charlotte, North Carolina: Information Age Publishing.
- Senge, P. M. (1997). The fifth discipline. *Measuring Business Excellence*, 1(3), 46-51.
- Seymour, E. (2001). Tracking the process of change in US undergraduate education in science, mathematics, engineering, and technology. *Science Education*, 86, 79–105.
- Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences* (Vol. 12). Boulder, CO: Westview Press.
- Stake, R. E. (1995). *The art of case study research*. Sage.
- Stephenson, K. (2005). Trafficking in trust: The art and science of human knowledge networks. In L. Coughlin, & E. Wingard (Eds.), *Enlightened power: How women are transforming the practice of leadership* (pp. 242-265). San Francisco: Jossey-Bass.
- The White House. (2009). Press release: President Obama launches 'educate to innovate' campaign for excellence in science, technology, engineering & mathematics (STEM) education. <http://www.whitehouse.gov/the-press-office/president-obama-launches-educate-innovate-campaign--excellence-science-technology-en>. Accessed 28 May 2010.

- Trigwell, K., & Prosser, M. (2004). Development and Use of the Approaches to Teaching Inventory. *Educational Psychology Review*, 16(4), 409–424. doi:10.1007/s10648-004-0007-9
- Trigwell, K., Prosser, M., & Ginns, P. (2005). Phenomenographic pedagogy and a revised Approaches to teaching inventory. *Higher Education Research & Development*, 24(4), 349–360. doi:10.1080/07294360500284730
- Uhl-Bien, M., & Marion, R. (2009). Complexity leadership in bureaucratic forms of organizing: A meso model. *The Leadership Quarterly*, 20(4), 631-650.
- Uhl-Bien, M., Marion, R., & McKelvey, B. (2007). Complexity leadership theory: Shifting leadership from the industrial age to the knowledge era. *The Leadership Quarterly*, 18(4), 298–318.
- Weaver, G. C., Russell, C. B. & Wink, D. J. (2008). Inquiry-based and research-based laboratory pedagogies in undergraduate science. *Nature Chemical Biology*, 4, 577-580.
- Weibler, J., & Rohn-Endres, S. (2010). Learning conversation and shared network leadership: Development, Gestalt, and consequences. *Journal of Personnel Psychology*, 9(4), 181.
- Wieman, C. E., Perkins, K. K., & Gilbert, S. (2010). Transforming science education at large research universities: A case study in progress. *Change*, 42 (2), 6-14.
- Yin, R. K. (2009). *Case study research: Design and methods* (Vol. 5). sage.

APPENDIX A

HUMAN SUBJECTS INSTITUTIONAL REVIEW BOARD CORRESPONDENCE

WMU's Institutional Review Board Letter

Date: November 24, 2010

To: Charles Henderson, Principal Investigator
Kathleen Quardokus, Student Investigator

From: Amy Naugle, Ph.D., Chair

Re: Approval not needed for protocol 10-11-21

This letter will serve as confirmation that your project "Evaluation and Formative Feedback for Engaging Young Scientists Project" has been reviewed by the Human Subjects Institutional Review Board (HSIRB). Based on that review, the HSIRB has determined that approval is not required for you to conduct this project because you are evaluating a project and are not collecting personal information about individuals. Thank you for your concerns about protecting the rights and welfare of human subjects.

A copy of your protocol and a copy of this letter will be maintained in the HSIRB files.

Change Initiative's Institutional Review Board

Charles Henderson

From: Agnitsch, Kerry A [ORR] [kagnitsc@iastate.edu]
Sent: Thursday, November 18, 2010 5:00 PM
To: Craig Ogilvie; Charles.Henderson@wmich.edu
Cc: Ament, Diane K [VPRED]; Stoehr, Alissa K [ORR]; Bappe, Roxanne L [ORR]
Subject: IRB review of "Evaluation and Formative Feedback for Engaging Young Scientists Project"

Hello Dr. Ogilvie and Dr. Henderson,

It was nice talking with you yesterday about your project "Evaluation and Formative Feedback for Engaging Young Scientists Project". My understanding from that conversation was that there is going to be a subcontract in place specifying Dr. Henderson's role in the evaluation component. Additionally, the project was submitted to the IRB at Western Michigan, and they asked that you contact the ISU IRB to see whether we should handle the review.

I have spoken with our director, Diane Ament, about the review of your project. Because there is a subcontract with Western Michigan for this component of the study, and Dr. Henderson will lead the evaluation and is employed by Western Michigan, we both feel that the IRB at Western Michigan should review this project.

Dr. Henderson had noted that the Western Michigan IRB wanted some kind of notification that we are okay with them reviewing the study. If they need notification beyond this email, please let me know and we can draft a more formal letter to send.

Thanks again for your time yesterday, and best of luck with your project—it sounds very interesting!

Kerry Agnitsch, Ph.D.
Co-Chair, Institutional Review Board
Office for Responsible Research
Iowa State University
1138 D Pearson Hall
Ames, IA 50011

515.294.4271

"Not all those who wander are lost." J.R.R. Tolkien

APPENDIX B

SEMI-STRUCTURED INTERVIEW PROTOCOLS

Year 1: February**For FLC Co-Facilitators**

1. What are your goals for the FLC? (i.e., What are the desired outcomes?)
2. How are you structuring the FLC to meet these goals?
3. What preparations have you engaged in? (e.g., collected materials, done reading on FLCs, etc.)
4. What concerns do you have or what problems do you anticipate?
5. What type of experience do you have in this sort of facilitator role? How comfortable do you feel in it?

Clarification:

1. What do you think your role as a facilitator includes?
2. How much time do you expect to spend on your FLC facilitator duties?
3. How much time do you expect your community members to spend on activities?
4. Do you feel that having a co-facilitator will be helpful or hurtful? In what ways?

Year 1: March

For Administrators

1. What is your relationship with/involvement in the project?
2. What do you know about the goals of the project and to what extent do you agree with these goals?
 - a. Probing
 - i. What do you know about the project activities?
 - ii. Do you think that the project is on track to meet these goals?
3. How do you expect the project to benefit your department?
4. Do you see any potentially negative impacts from the project?
5. What do you think are the general levels of knowledge about and agreement with the goals of the project in the department?
 - a. Probing
 - i. Do you have any suggestions for how to increase knowledge or agreement?
 - ii. Are there different groups of people in the department with different views of the project?
6. Ideally, how would you like things to be different in 3 years, as the project nears completion?
7. To what extent do you think that project will have a long-term impact on the department?
8. What other efforts to improve teaching in the department have occurred in recent history?
9. In general, what do you think that the department and institution do well to promote teaching excellence? What do you think the department or institution does that hinder teaching excellence?
10. Are there other comments or suggestions that you have along these lines?

For Faculty

1. What is your relationship with/involvement in the project?
2. What do you know about the goals of the project and to what extent do you agree with these goals?
3. What do you consider to be the main activities that the project is using to meet these goals?
 - a. For each activity mentioned (e.g., FLCs)
 - i. What parts of _____ do you think have worked well?
 - ii. What parts of _____ would you suggest changing? (and, how?)
4. How have you benefited so far from your participation in the project? What benefits do you anticipate in the future?
5. How do you expect to be involved in the project during the next three years?
6. If the project did not exist, to what extent do you think you might be engaged in similar or related educational reform work on your own or as part of a different project?
7. How do you expect the project to benefit your department?
8. Do you see any potentially negative impacts from the project?

9. What do you think are the general levels of knowledge about and agreement with the goals of the project in the department?
 - a. Probing
 - i. Do you have any suggestions for how to increase knowledge or agreement?
 - ii. Are there different groups of people in the department with different views of the project?
10. Ideally, how would you like things to be different in 3 years, as the project nears completion?
11. To what extent do you think that project will have a long-term impact on the department?
12. In general, what do you think that the department and institution do well to promote teaching excellence? What do you think the department or institution do that hinder teaching excellence?

For Post Doc

1. What attracted you to this position?
 - a. Probing
 - i. How do you expect this experience to help you in the future?
2. What do you know about the goals of the project and to what extent do you agree with these goals?
3. What do you consider to be the main activities that the project is using to meet these goals?
 - a. For each activity mentioned (e.g., FLCs)
 - i. What parts of _____ do you think have worked well?
 - ii. What parts of _____ would you suggest changing? (and, how?)
4. How have you benefited so far from your participation in the project? What benefits do you anticipate in the future?
5. How have you contributed to the project so far? How do you expect to contribute in the future? Are you happy with your role and your interactions with other people?
6. What has been the most difficult part of your work on the project so far?
7. How do you expect the project to benefit the participants, the participating departments, or the institution in general?
8. Do you see any potentially negative impacts from the project?
9. What do you think are the general levels of knowledge about and agreement with the goals of the project in the department?
 - a. Probing
 - i. Do you have any suggestions for how to increase knowledge or agreement?
 - ii. Are there different groups of people in the department with different views of the project?
10. To what extent do you think that project will have a long-term impact on the department?

11. In general, what do you think that the department and institution do well to promote teaching excellence? What do you think the department or institution do that hinder teaching excellence?

Year 2: October

For Involved Instructors

13. What is your relationship with/involvement in the project?
 - a. How did you originally hear about the opportunity?
 - b. How did you become involved? (When?)
 - c. What initially sparked your interest in becoming involved?
 - d. If you were not involved from the beginning, did you hear about the project prior to becoming personally involved? Who did you hear from?
 - e. What were your initial impressions of the grant? (Probes: plans, goals, approach) Have these impressions changed over time?
14. Who are the 5 people that you talk to most frequently about teaching?
 - a. What kinds of things do you talk about? (Probe: project or other?)
15. Have you thought about or made any changes to your courses/teaching practices due to your involvement in the project?
 - a. For each activity mentioned
 - i. What influenced you to choose _____ strategy?
 1. Probe: people, article, speaker, discussion in flc
 - ii. Where did you gain information about this strategy?
 - iii. What resources have you used to implement changes?
 - iv. Have you had any notable successes due to these changes?
 1. Did you share any of these experiences with any of your colleagues
 - v. Have you experienced any difficulties in planning/implementing/assessing the strategy?
 - vi. How are you handling these situations?
 1. Have you received any advice or used resources from other faculty members or people at the institution?
 2. Have you shared any “lessons learned” with other faculty members?
 - b. For Learning Objectives
 - i. Are you teaching E201 or D202?
 - ii. Have you changed your learning objectives?
 - iii. How has this changed your preparation/course/assessments?
 - iv. Are you working with the post-doc or using her modules?
 1. How much do you know about them?
 2. Do you have any suggestions for improvement?
16. Are you aware of any of other department members implementing changes?
 - a. How did you know about these?
 - b. Have you given advice to this person or shared ideas?
17. How do you expect to be involved in the project during the next two years?
18. If the project did not exist, to what extent do you think you might be engaged in similar or related educational reform work on your own or as part of a different project?

19. Can you imagine any way that the project might help you with your teaching responsibilities (e.g., individual consultation related to teaching, new information)?
20. Ideally, how would you like things to be different in 2 years, as the project nears completion?
21. In general, how are things going? (is the grant meeting your needs)
22. Do you have any comments or suggestions for the near or distant future?

For Less-involved Instructors

1. What is your relationship with/involvement in the project?
- a. When did you originally hear about the HHM project? What did you hear? Who did you hear from?
- b. What are your impressions of the grant? (Probes: plans, goals, approach)
2. We are trying to get a broad understanding of the department needs, do you have suggestions of how the project could be useful for you?
3. Intro to talking about teaching
- b. Who are the 5 people that you talk to most frequently about teaching?
 - a. What kinds of things do you talk about? (Probe: project or other?)
- c. Are you teaching any introductory course?
 - a. What do you try to accomplish in your introductory/large lecture course? Content, critical thinking?
- d. Can you imagine any way that the project might help you with your instruction of these courses (e.g., individual consultation related to teaching, new information)?
- e. Have you been aware of activities of the project (learning community, seminar, piloting materials)? (Have you taken advantage of that?)
- f. A proposed faculty learning community on the higher order thinking had limited interest. Do you have any thoughts about why this was the case? (Follow up: do you think this is due to topic? Time commitment? Style of the learning community? (if needed) Is there a specific reason you chose not to join?
- g. Are you aware of any of other faculty members implementing changes?
 - a. How did you know about these?
 - b. Have you given advice to this person or shared ideas?
- h. Do you expect to be involved in the project during the next two years?
- i. Even though you are not involved, to what extent are you engaged in similar or related educational reform work on your own or as part of a different project?
- j. Ideally, how would you like things to be different in 2 years, as the project nears completion?
- k. Do you have any comments or suggestions for the near or distant future?

For Post-Doc

1. What interaction have you had with the leadership of the grant/the D and E dept?
2. How has your development of modules advanced?
3. Who/what have you used to gain advice on content/style/assessment?
4. Have you noticed any useful ideas from the FLC put into practice by faculty members?

5. In general, what has been happening during the FLC this year?
6. Do you things are generally better than last year or worse?

Administrators:

1. What is your relationship with/involvement in the project?
 - a. How/when did you originally hear about the grant?
 - b. What were your initial impressions of the grant? (Probes: plans, goals, approach) Have these impressions changed over time?
 - c. What do you see as your role in relation to the grant as a dept chair?
 - d. In the future, would you like to be more or less involved with the project?
2. Are you aware of any of the faculty members implementing changes?
 - a. How did you know about these?
 - b. Have you given advice to this person or shared ideas?
3. Do you feel you have taken any actions in the department that have influenced the involvement of faculty member?
4. How do you expect to be involved in the project during the next two years?
5. We are trying to get a broad understanding of the department needs, do you have suggestions of how the project could be useful for you?
6. Do you have any comments or suggestions for the near or distant future?

Year 2: December/January**For individuals who declined Intro FLC invitation**

1. Are you teaching introductory/large lecture course?
2. How long have you been teaching introductory/large lecture course?
3. What goals do you have for your introductory/large lecture course?
4. What are the biggest problems that you face in your teaching?
5. What have been your interactions so far with (or what do you know about) the this change initiative? (follow up: do you know people who have participated in project activities? Have you been invited to participate?)
6. Can you imagine any way that the project might help you with some of these problems (e.g., individual consultation related to teaching, new information)?
7. The faculty learning community for introductory large lecture instructors had limited interest. Do you have any thoughts about why this was the case? (Follow up: do you think this is due to topic? Time commitment? Style of the learning community? (if needed) Is there a specific reason you chose not to take part in the FLC?)

Year 4: November

For PI

1. What do you see as the strengths/weaknesses of the project?
2. What do you see as your role?
3. Some decisions/meetings were made because of the SNA, did you notice any benefits/challenges with using this method?
 - a. *optional compare before network was known to after*
4. Now I want to talk about specific changes in each department
 - a. If there is time, discuss a particular change that occurred in each department
 - A. what do you know about the change? Who was involved? What was your role? when did the idea start, how did implementation go? what were some challenges, rewards?
 - b. If there is limited time, choose most exciting change, or most notable change and discuss it.
 - A. what do you know about the change? Who was involved? what was your role? when did the idea start, how did implementation go? what were some challenges, rewards?

For Post Doc

1. What do you see as the strengths/weaknesses of the project?
2. What do you see as your role? What do you see as the PI's role?
3. Have you noticed any changes in the department? or are you aware of things that are different now than what they used to be? (even if the way they used to be was before you arrived)
 - a. what do you know about the change? Who was involved? What was your role? when did the idea start, how did implementation go? what were some challenges, rewards?
4. How valued is high quality teaching at this institution, (college, department)?
 - A. How did you form these opinions?
5. What does the institution, college department do to promote high quality teaching?
 - A. Is there language used by the department, college, or university to talk about teaching ideals of the university?
 - a. Where do you hear this language/who/what places (Does there seem to be faculty buy-in/participation)
 - b. How do you interpret these "mottos, ideas, language?"

For Teaching and Learning Center Individuals

1. Intro: I am from but am interested in an outside view of the Departments involved in the project : A, B, C, D, and E.
2. What have you heard about the project?
3. Do you see Teaching and Learning Center as working with project or on similar things but not necessarily together or completely different?
4. Have you been in contact with any faculty members involved in change initiative changes? What have they wanted to talk about?
5. Have you noticed any changes with your interactions with the departments throughout the project?
6. How valued is high quality teaching at this institution, (departments)?
 - A. How did you form these opinions?
7. What does the institution, (departments) do to promote high quality teaching?
 - A. Is there language used by the university to talk about teaching ideals of the university?
 - a. Where do you hear this language/who/what places (Does there seem to be faculty buy-in/participation)
 - b. How do you interpret these “mottos, ideas, language?”
 - c. Do you feel these ideas impact your personal teaching discussions?

For Chair/Faculty/ lecturer/lab coordinators

1. Intro: Although this interview is part of the change initiative, we are also interested in what is generally happening in the department.
2. In the last 3 years, [courses changed] have been recorded by the change initiative to have changed teaching practices. But we know there is more going on, and want to get an idea about the process that led to these changes.
 - A. I'll ask more detailed questions about this later, but in general what do you know about these changes?
 - B. Are you involved in any of these courses? What is your role?
 - C. Is this a complete list? Is anything missing from the list? Have you noticed any other changes (with respect to teaching)?
 - a. *optional: Would you add or delete anything, why?*
 - b. *optional: What evidence of change have you seen?*
3. Now I'm going to focus on specific courses that you have been involved in. If answer to 2B is yes, what was the sequence of events that led to you becoming involved in change? (Focus on 1 at a time or multiple depending on how the interview goes).
 - A. What changes have you made? How did these happen? Where did these ideas come from?
 - B. What worked well? What barriers to change were there?

- C. When you first started, how did you expect the project to go? How does this compare to what did happen?
 - D. Where did you find encouragement/discouragement?
 - a. *Optional: Did you receive any recognition? or feel rewarded (intrinsically, extrinsically)?*
 - E. *Optional: Were you approached by a specific person?*
 - F. *Optional: Did you have any reservations?*
 - G. Did you feel any pressure to make this change (or not make any changes)? (Internally or externally?)
 - H. Who do you talk to about your involvement in change?
 - I. Has your involvement introduced you to new people? or strengthened any relationships? How did this happen?
4. If answer to 2B is no or following 3. You mentioned knowing something about changes in other courses: (Reference 2A)
 - A. What changes have you heard about? Who was involved? Do you know how these changes occurred or where the ideas came from?
 - B. Have these changes worked well? What barriers to implementing change did other encounter?
 5. Remind him/her of the social network surveys
 - A. Have responses available: This is who you mentioned talking to about teaching at the end of last academic year.
 - a. Do you think this list is still accurate?
 - b. When we say “discussions about teaching” what are you talking about?
 - B. Do opinions about teaching seem to vary from person to person, or is generally everyone on the same page?
 - C. *Optional: Can you give an example of one of these conversations – perhaps the most memorable or interesting*
 6. How valued is high quality teaching at this institution, (college, department)?
 - A. How did you form these opinions?
 7. What does the institution, college department do to promote high quality teaching?
 - A. Is there language used by the department, college, or university to talk about teaching ideals of the university?
 - a. Where do you hear this language/who/what places (Does there seem to be faculty buy-in/participation)
 - b. How do you interpret these “mottos, ideas, language?”
 - c. Do you feel these ideas impact your personal teaching practices/discussions?

APPENDIX C

TEACHING AND LEARNING SURVEY

1. How often do you have substantive discussions with your colleagues about teaching?
 - Nearly every day
 - Once a week
 - Once a month
 - Once a semester
 - Less than once a semester
2. How much do you pay attention to developments in research on learning in your field?
 - I follow closely
 - I am aware of the major developments
 - I sometimes turn to it when seeking an answer to a specific question
 - I do not pay attention to it
3. How important is teaching excellence in tenure and promotion decisions in your department?
 - Teaching excellence is required
 - Teaching excellence is helpful, but not required
 - Teaching excellence is not important
4. Does your department support faculty efforts to adopt new teaching methods?
 - Yes, financial support and/or course release time is available
 - Yes, adopting new teaching methods is encouraged, but no direct support is available
 - No faculty are free to teach as they wish (adopting new teaching methods is neither encouraged nor discouraged).
 - No, adopting new teaching methods is discouraged
5. How traditional are your teaching practices as compared to those of your colleagues?
 - Much more traditional
 - Somewhat more traditional
 - About the same
 - Somewhat less tradition
 - A lot less traditional

APPENDIX D

DETAILED DEPARTMENT NARRATIVES

Department A

Overview

Department A has 60 members. The change initiative affected seven courses (A101L and A102L, A201 and A202L, A301L, A302, and A303). Nine members of department A were involved in the change initiative. This includes the PI of the project. The members of one of the sub-disciplines in department A were particularly active in the change initiative (this is referred to as “sub-discipline A” throughout the results section). Table 6.1 provides a summary of change initiative participants’ demographics in department A. The following section presents short biographies of each individual.

Table 6.1 Individuals who play important roles in department A’s change narrative and their role in the change initiative

Name	Title	Change Initiative Role(s)	Sub-discipline A Membership
Alexis	Lecturer	Manage A101L/A102L and A201L/A202L	
Michael	Associate Professor	FLC member (Laboratory), Teach A301L/A302	X
Kara	Associate Professor	FLC member (300 level lecture), Teach A303	
Jackson	Professor	PI	
Clark	Associate Professor	FLC facilitator (Laboratory)	X
A_Y	Professor	FLC member (Laboratory)	
A_VV	Professor	FLC member (Laboratory)	X
A_AAA	Professor	FLC member (300 level lecture)	
A_PP	Professor	FLC member (Introductory lecture)	
A_Z	Beginning Chair	NA	
A_FF	Concluding Chair	NA	X

Alexis. Alexis is a lecturer in charge of the service courses of the department. She trains the TA's and has authority over the design of the courses. Alexis attended a change initiative sponsored summer workshop during the first summer. She made changes to the freshman and sophomore laboratories (A101L/A102L and A201L/A202L).

Kara. Kara is an associate professor in the department. She was member of the 300 level lecture FLC during the third year of the change initiative. She offered to pilot the use of learning assistants in A303 and reported her experiences back to the FLC and the department. Kara is married to Michael.

Jackson. Jackson is the PI of the change initiative. He has been a member of department A for many years. His main interaction with the change initiative activities is meetings with the Co-PIs, post-docs, and FLC facilitators to guide the direction of the change initiative activities.

Michael. Michael is a member of sub-discipline A (which had many individuals involved in the change initiative). Michael made changes to two courses, A301L and A302. These courses are taken during the junior level year of majors of the sub-discipline. They are both stand-alone courses. Michael attained tenure during the change initiative and attended the laboratory and research FLCs throughout. Michael is married to Kara.

Setting the Stage

The individuals who had already been interested in making changes played a large part in determining what changes were made during the initiative. First, Alexis had begun to discuss better ways to design laboratories before the change initiative began. Alexis was the lecturer in charge of the service laboratories of the department and had already begun to discuss the possibility of improving them with faculty members. Second, Michael also had already begun to think about what changes could be made to his two courses. For the laboratory course, A301L, Michael felt restrained by the instrumentation available. He felt that the course represented more of a science “club” rather than a course where students learned to act like scientists. He began to think about how he would improve the course before the change initiative occurred. His other course, A302, the department had recently split from one semester into two semesters. With less content to cover, A302 had more flexibility to add new teaching techniques, which influenced its appropriateness for the changes recommended by the initiative. Finally, Kara also mentions having been interested in including active learning in her lectures, and Jackson had been interested in education improvement.

Department A expects excellence in teaching from its members. For example, a department member argues that teaching expectations are high in the department. He explains, faculty are expected to do well in their position as educator, but this is not tied to any specific teaching strategies. Despite this expectation, members of department A acknowledge the research prowess is still the most important aspect of tenure considerations.

The Beginning Years

In the beginning, the change initiative benefited from building upon the opportunities for change within the department. For example, Clark identified one of the main goals of the FLC was to learn about what people were already doing and to learn from local experts on Nature of Science. Jackson also was interested in funding individuals who were motivated to make changes and had a vision for change. These activities led to identifying the courses where Alexis and Michael were already implementing or were willing to make changes.

In the beginning, some activities did not necessarily lead to entire course changes. For example, A_PP attended the introductory lecture FLC. He was very positive about what he learned in the meetings, particularly with Nature of Science learning objectives. However, the FLC did not continue which did not allow him to find a way to implement what he had learned. He also felt that introductory courses in department A were not advanced enough to really consider Nature of Science topics. The FLC membership likely influenced his teaching but not in an entire course change.

In addition, A204 was identified as a possible course for improvements related to the change initiative. Some Nature of Science activities were added to A204, but it was not identified by the change initiative as a participating course. This may be an indication of indirect impact of the change initiative on the department.

A101L/A102L and A201L/A202L. Alexis made the changes to the laboratory courses for the first and second year students. Alexis is the laboratory coordinator for the department. She spends a lot of time training and guiding teaching assistants. In the first

summer of the change initiative, Alexis attended a summer workshop. She used this experience to inform an inquiry-based rewrite of the 100 and 200 level laboratories. These are the “service” courses of the department and have large enrollment numbers. She acted mostly independently of the department. She made and implemented the changes based on her own authority (she did not ask permission from the chair or the curriculum committee). Although, she had worked with other department members in the past, and it is likely she was aware that they would have approved of the changes.

Throughout the process, she shared her experiences with the laboratory FLC. Jackson felt that her large scale change (four courses) helped motivate others by providing an example of how big changes could be.

Jackson describes the changes in the 100 and 200 laboratory courses as being motivated by Process Oriented Guided Inquiry Learning (POGIL) (POGIL, 2014). Before the changes, the laboratories were traditional “cookbook” labs. Students followed specific instructions to obtain results. In their new form, the TA leads the class in studying a “question of the day.” First, each research group writes a question on the board that they think is the most important question to answer. As a class, the students decide which question to pursue. The TA then guides them in designing and carrying out experiments. At the end of the session, each group writes their results on the board and the class answers the “question of the day.”

A301L. A301L is a small, stand-alone laboratory course for juniors in sub-discipline A. The class is three credits and size ranges from 6-15 students. According to Michael, prior to the change initiative, A301L resembled more of a “science club”

experience. Students had the opportunity to observe phenomena, but not actively participate in collecting and analyzing data. Through equipment purchases made possible by the change initiative, the course became more quantitatively based and allowed students to complete projects they had designed and collected data for themselves.

The course consists of introductory laboratories where students learn process skills in using equipment and using analytical methods, followed by an open-ended project. The students propose the research that they want to complete, and then Michael helps them refine their ideas, collect and analyze data, and present their results in a paper, including primary references. Throughout the process, Michael allows the students to make minor mistakes and learn from them, but guides students enough to keep them on track during the course.

The main motivation for changing the course was to include quantitative data analysis. Michael knew what he wanted to do with the course, but needed money from the department and the change initiative to purchase equipment to make it possible.

A302. Michael was also in charge of the changes to A302. This is a lecture course with an enrollment of 30 to 50 students. The course was recently split into two separate courses. This meant that more time was available in A302 to add inquiry-based projects. Michael implemented a project where students propose questions that they can answer with publicly available data. This project can take the place of the final exam, although it is optional. Approximately a third of the students choose to do the project, and the remaining two thirds take the final exam. The project also takes the place of some of the typical homework assignments.

Social networks. Two features related to the social network are important for the change that took place in department A in the beginning years. First, one of the main hubs of knowledge (many connections) in the department is Jackson, the PI of the grant (Figure 6.1). This allowed him to have access to information about who would be interested in participating in the change initiative and making course changes. It may have been more difficult for an outsider to identify these individuals who had considered or were engaged in changing courses. Second, the blue subgroup in Figure 6.1 represents the sub-discipline A. The sub-discipline is removed from the knowledge in the rest of the network. Conversely, information is easily shared amongst the sub-discipline. In fact, sub-discipline A has weekly group meetings. At these meetings, education and teaching concerns frequently come up and sometimes they discuss specific students because the sub-discipline is relatively small. The subgroup in the social network shows the effect of this frequent meeting and sharing of information about teaching.

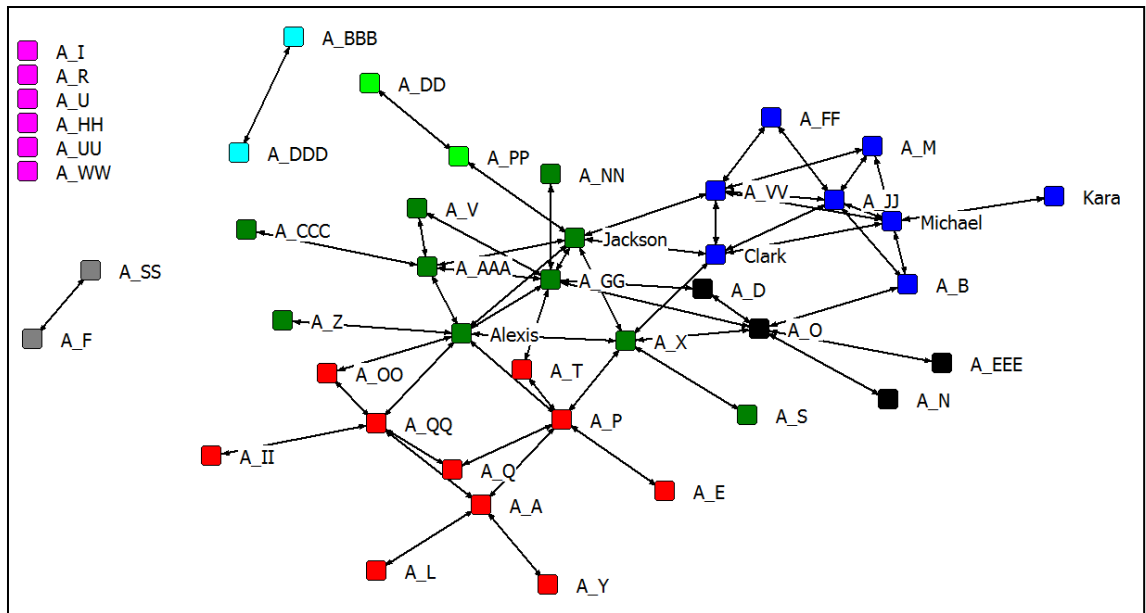


Figure 6.1 Teaching discussion network of department A in the beginning years

Concluding Years

In the concluding years, the original developers in department A continued many of the same changes. This shows commitment of the people involved to continue to make changes. Also, the sub-discipline A course (A301L) will be transferred from the original developer to a second instructor in the year following the change initiative.

Department A members began to talk about the challenges of training TAs in the beginning years. The FLCs spoke about how to train them (ask graduate students themselves, or seek advice from other departments) and Alexis struggled with training them to use inquiry-based techniques. At the conclusion of the grant, the TA training challenge had not been resolved.

Michael achieved tenure during the change initiative process. He recognizes that as a non-tenured faculty member, it may not have been wise for him to focus on

extensive instructional changes. Although, he felt motivated to do so based on his belief about how courses should be taught. He does believe that being involved in a prestigious university-wide grant may have helped his cause, but the changes in the classroom were not as important.

A101L/A102L and A201L/A202L. Alexis continued the changes with the freshman and sophomore laboratories. TA training is the major concern moving forward with the laboratories. She knows that some TAs vary in the implementation of inquiry. Some of the TAs are resistant to the inquiry-based technique and undermine the new design of the laboratories, while others are consistent with the intention of the laboratories. Alexis continues to work on these concerns.

A301L. Clark will take over the laboratory course in year following the fourth year of the change initiative. Throughout the process of change, Clark worked closely with Michael to purchase the equipment and design the laboratory. He attended the course and spoke frequently with Michael about implementation. He intends to continue to teach the course in the same manner as Clark.

A302. Michael continues to refine changes to A302. All of the major changes to the course were made in the beginning years.

A303. A303 is a lecture course that underwent changes during the concluding years of the change initiative. Kara had heard about how a different university had used

learning assistants to facilitate active learning in the classroom. She wanted to try this approach in her classroom. At the time (third year of change initiative), she was a participant in the 300 level lecture faculty learning community. She volunteered to pilot a learning assistants program in her A303 course for the FLC and her department. If this model worked well in A303, the department would consider funding the learning assistants for similar courses. During the first two years, the learning assistants were funded by the change initiative.

The learning assistants helped with problem solving activities. Instead of Kara going over the problems on the board, the students worked in small groups while the learning assistant and Kara walked around and facilitated their problem solving.

Informally, student homework grades, exams and evaluations indicated that learning assistant had a positive influence on the learning experiences in the course. Kara would have liked to spend more time on formal assessment of student outcomes.

Kara valued being part of the learning community throughout the change process. It gave her the opportunity to think about and share what was working and what was not working and make changes throughout the implementation. The following semester, the other instructor of the course also used the learning assistant. Kara believes the use of learning assistants will continue in the course, and will continue to use them herself.

Social networks. In the concluding years, department A had more overall connections and more connections across subgroups. For example, the average number of individuals named by a respondent increased from 3.5 in the beginning years to 4.9 in the concluding years. Jackson continues to be an important hub of information, but for

both the discussion and advice network (Figure 6.2 and Figure 6.3). Sub-discipline A continues to be a subgroup of the network (gray in discussion network Figure 6.2, and pink in the advice network Figure 6.3). This means Jackson is still very important for spreading information in the network and that sub-discipline A remains removed from the rest of the department. It is noticeable in the advice network that the connectors between sub-discipline A and the rest of network consist of the connection of Kara and Michael (marriage) and Hannah of department B. This may indicate that changes adopted and discussed by sub-discipline A are not going to be shared with the rest of the network.

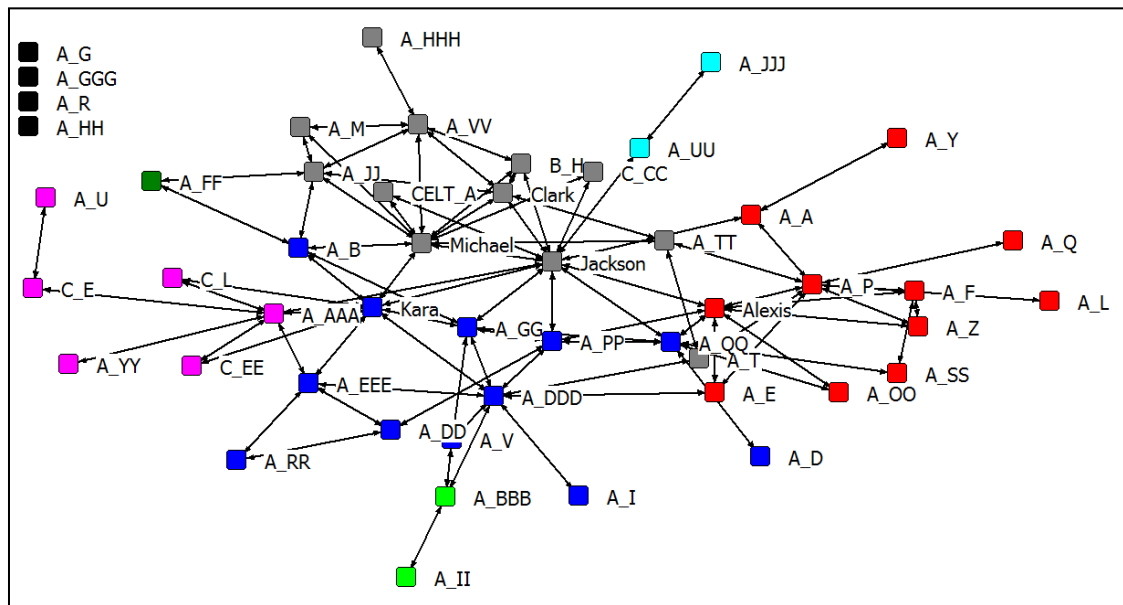


Figure 6.2 Discussion network of department A during the concluding years

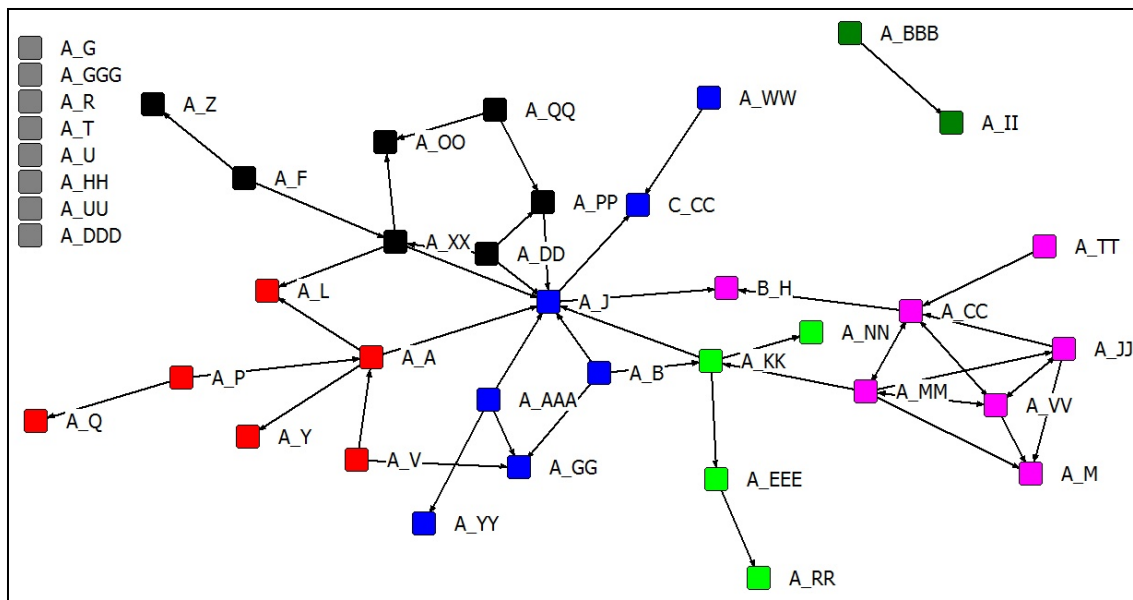


Figure 6.3 Advice network of department A during the concluding years

Department B

Overview

Department B had twenty-five members during the fourth year of the initiative. (The department hired two new faculty members during the four years.) The department combines two relatively distinct disciplines (labeled discipline 1 and 2 in Table 3). Large-scale curriculum changes in two of department B's courses were directly related to the change initiative (B100L and B300). One course was based in each of the disciplines of the department. Six members of department B participated in change initiative activities. Table 6.3 provides a summary of change initiative participants' demographics and the following section presents short biographies of each individual.

Table 6.3 Individuals who play important roles in department B's change narrative and their role in the change initiative

Name	Title	Change Initiative Role(s)	Discipline
Cora	Graduate Student	FLC member (Laboratory), Evaluate B100L	1
Hannah	Professor	Co-PI, FLC member (Laboratory), Teach B100L	1
James	Senior Lecturer	FLC Member (Laboratory), Teach B300	2
Tim	Professor	FLC Facilitator (Laboratory)	2
Everett	Professor	FLC Member (Introductory lecture)	1
Wilson	Assistant Professor	FLC Member (300 level lecture)	1
Quincy	Current Chair	NA	NA
Fred	Former Chair	NA	NA

Cora. Cora was a graduate student in department B. She had previously received her bachelor's degree from the same department. She was recruited by Hannah to evaluate the Nature of Science learning gains of students enrolled in B100L as her master's thesis. She had previously taken B100L and provided insight into student perceptions of the course prior to change. By the fourth year of the initiative, she had graduated with her Master's Degree and the department had hired her to teach a different course. She remains involved in B100L implementation, including TA training.

Hannah. Hannah is a Co-PI of the change initiative. She has been involved in college-wide change initiatives prior to the current program. She is in charge of B100L and was the faculty member in charge of changes to the course. She has been actively involved in the laboratory FLC throughout the change initiative.

James. James is a senior lecturer in charge of B300. He has been involved in the laboratory FLC throughout the change initiative and has discussed the course changes with Tim throughout the process.

Tim. Tim does not teach either of the courses that were changed. Prior to this change initiative, he had been involved in developing innovative teaching techniques with Hannah and other individuals from the institution. He has been involved in the laboratory FLC throughout the initiative.

Everett. Everett was involved in the introductory level FLC during the first year of the change initiative. This FLC focused on how to teach students to “think like a scientist.” Everett was not involved in the two large-scale curriculum changes of B100L or B300. However, Everett did add a Nature of Science lecture to a course he was teaching as a result of his involvement in the Introductory lecture FLC.

Wilson. Wilson joined the 300 level lecture FLC during the third year of the change initiative. He is new to the department. His discussions about teaching have increased significantly during the year he was involved in the FLC.

Fred. Fred is the former chair, and finished a ten-year role as department chair midway through the change initiative.

Quincy. Quincy was department chair for the remainder of the change initiative's two years.

Setting the Stage

Three individuals have shown interest in education concerns in the past. Hannah, Tim, and B_G all identify education concerns as one of their research interests. Hannah has been the most involved in instructional practices, listing education research as her primary interest and being involved in multiple efforts to improve teaching. Tim and Hannah were both involved in a previous change initiative that focused on improving Nature of Science education at the institution. This project may have been an important precursor to the current change initiative because it included many of the leaders of the current change initiative (from all of the departments) and used faculty learning communities to promote change. This grant is one of the ways that Tim and Hannah became familiar with the larger institutional community interested in improving science education.

Prior to the current change initiative, the department as a whole has supported instructional excellence. Tim described the relationship between the department and excellence in teaching when he reflected upon his experience with the department's tenure and promotion procedures. He says that overall teaching is an important part of promotion and tenure review. He provides evidence from his own experiences. He notes that the chair (both the current and former) have always complimented him on his teaching and his recognition for teaching by the institution. Tim views this as positive reinforcement of his efforts to improve his own teaching.

However, not all of the characteristics of the previous state of the department were positive towards teaching. The department also has a curriculum committee. Hannah observed that the committee “never” meets. Tim agrees that teaching only comes up occasionally with the curriculum committee chair when the course catalogs need to be changed. None of the other interviewees mentioned the curriculum committee. Based on these accounts it is unlikely that instructors in department B felt influenced to change or not change their courses due to influence by the curriculum committee.

The Beginning Years

The changes in department B occurred early in the change initiative timeline (beginning within the first year). This includes two course changes and one Nature of Science lecture during the first year of the change initiative.

During data collection in the beginning years, Hannah and James identified features that had the potential to influence change or had already contributed to limiting change. First, Hannah recognized the training of Teaching Assistants as a potential source of resistance for the planned change. She said at the beginning of the change initiative, she had little or no control over which TAs were assigned to her course. She felt that most TAs were underprepared to facilitate authentic research projects.

Second, Tim believes chair buy-in and support is necessary to convince members of the department to join the change initiative. He believes the chair values excellence in teaching but not education research. Hannah argues conversations with the chair should come from faculty involved in change but also from “higher up” in the change initiative.

She sees it as the responsibility of all of the participants to communicate with the dean about the activities of the change initiative.

Third, Tim noted that during the first year he already would have made changes to the FLC by focusing more on IRB protocol. This could have resulted in published articles on their change efforts; however, some people felt that they could not use data collected because they did not know to submit an IRB protocol in advance.

Participants also described the context of the department with respect to the change initiative. Although Tim describes the department as valuing teaching in tenure reviews, Hannah felt that the department was indifferent to her attempt to make changes in the course. She finds most of her support from outside of the department.

B100L. B100L underwent initial changes during the first year of the initiative. B100L is a one credit course. It has approximately 75 students each semester. Two-thirds of these students are non-majors. Hannah led the changes in B100L and was assisted by the graduate student, Cora. Cora was a former undergraduate of the department and had taken B100L. After graduation, she was recruited by Hannah as a graduate student; she based her master's thesis on Nature of Science assessment in B100L. Both Hannah and Cora attended the laboratory (later research) FLC during the implementation of change in B100L.

Hannah became interested in changing B100L before the change initiative started. She attended the laboratory FLC as a source of external support.

Hannah credits Cora with being a major influence of success for the changes in B100L. First, Cora was a former student who provided insight into how the class was

perceived by the students. Second, Cora could help with student's research projects because she was familiar with the research topic. Finally, Cora's thesis provided motivation for following through with formal assessment.

In the beginning of changes, Hannah faced a lot of challenges. She decided to adapt the CASPiE (Weaver et al., 2008) model for developing authentic research experiences within a course. First, she looked for colleagues who were willing to partner with undergraduates for research. The colleagues that had research that could be supported by the course were limited. First, the research needed to have existing data or data collected geographically close to the university. Hannah reached out to four diverse colleagues who were unwilling to contribute to the course. The reasons provided by the faculty members varied from not wanting to work with undergraduates to feeling that he did not have enough time. Hannah secured funding to buy equipment for the course that then dictated the type of research the course could do.

Hannah also contacted B_L (the other instructor of the course). During the early years, B_L was uninterested in creating a research experience because of the amount of coverage that would need to be sacrificed to include an intensive project. Jackson (the PI of the grant) feels that a main component of this transition was the excitement for change provided by the graduate students involved in the course (Cora and others).

B300. B300 underwent changes during the first year of the initiative. B300 is a four credit course taken by majors in the second semester of their sophomore year. Enrollment is usually between 30 and 35 students. James has been the main instructor involved with teaching and changing this course. In this course, James added a six-week

research project. In this project, students propose hypotheses, take measurements, reflect on their work and present findings. The measurements are either previously collected data or collected by the students using instruments that were purchased by the change initiative. Tim discussed many of the changes with James throughout the process of implementation (especially when the change was new).

For B300, the first process involved in changing the course was determining which content could be shortened in order to allow for a long-term project. One of the challenges in the first year was thinking of projects with the equipment that was available.

Social network. Social network analysis provides insight into why Hannah felt that support for change came from outside of the department. In the beginning years, the centralization of department B was relatively high (compared to networks of other departments.) This means a few key people (Everett and B_A in this case) have access to the most information in the network and can spread information easily. If either of these two individuals left the department, there would be very few discussions about teaching.

It is a positive aspect of department structure that a change initiative participant (Everett) is central in the network. Everett added a Nature of Science lecture into his course and felt it was a beneficial addition. His discussions about teaching with many people likely included information he learned from the introductory FLC and the experience of adding a Nature of Science lesson. However, the change initiative participants, Hannah, Tim and James, are not central in the network. This means their efforts did not have available discussions in order to be spread throughout the network.

Hannah says she gains support for teaching from individuals outside of the department, which helps explain her lack of discussions within the network. Overall, in year two, teaching discussion were not very frequent and were dominated by a subgroup that contained the former and current chair.

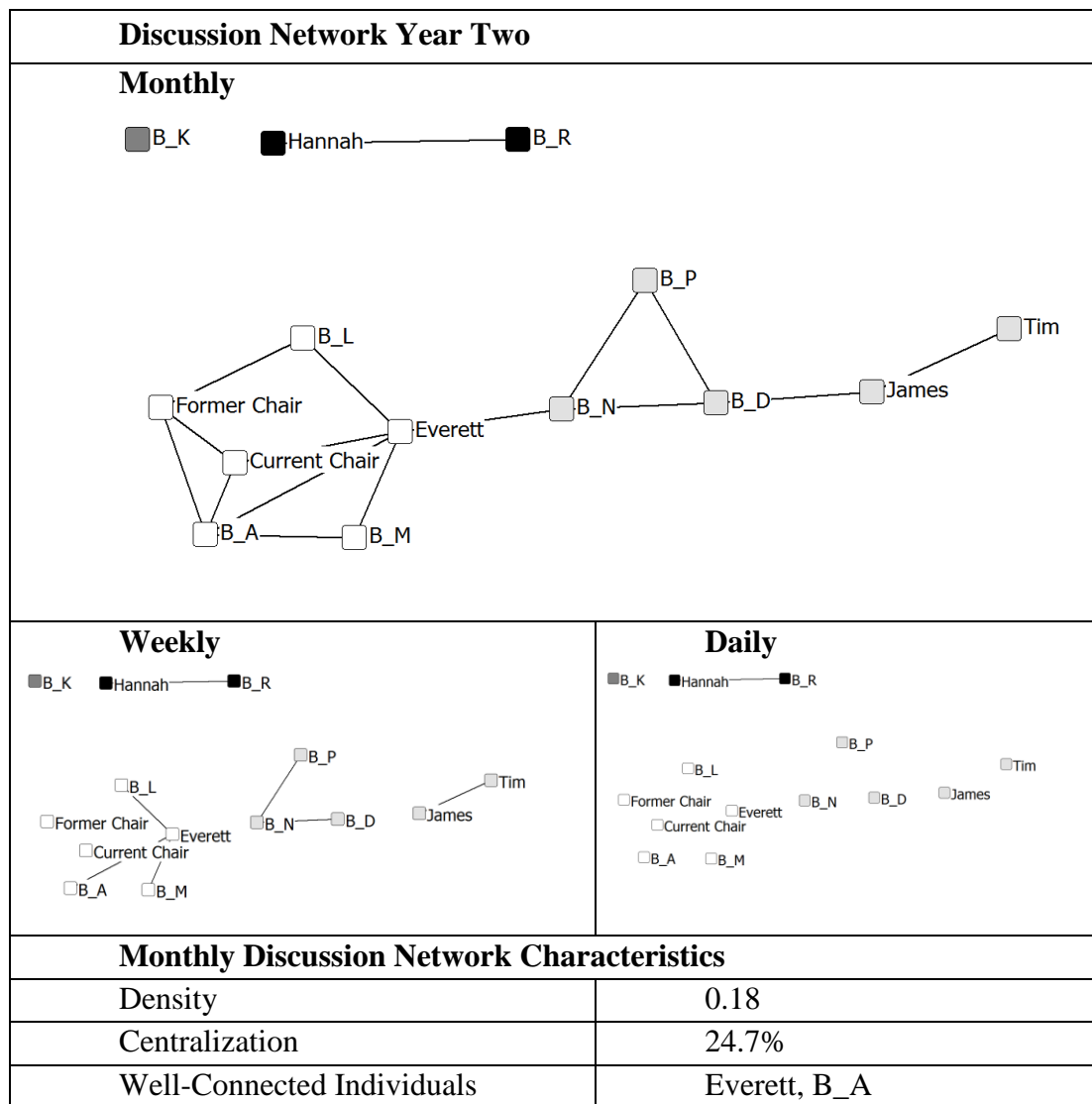


Figure 6.4 Result summary of department B's discussion network in year two. Subgroups identified by shading of nodes

The Concluding Years

Hannah, James, and Tim continued to be involved in course changes and FLCs. Tim became the co-facilitator of the research FLC. Everett did not continue to attend FLC meetings. Wilson joined the department and also started attending the FLC that focused on 300 level courses.

Teaching assistant training did continue to be an issue. Hannah addressed this by trying to stagger TAs, so TAs from previous years could help newer TAs. Cora was hired as an instructor and continued to work with TAs, as well as one TA acted as a supervisor to make the transition easier.

In the beginning years, a concern was the ability to publish results. In the concluding years, twelve members of the lab FLC collaboratively wrote an article on the experiences of changing lab courses. At the time of this report, the article was still under revisions for future publication.

Hannah and Tim continued to turn to colleagues outside of the department for support (specifically, the laboratory FLC participants). Hannah said that the lab FLC challenged her to think about student learning outcomes and how to reach those outcomes. According to Hannah and Tim, the few members that are interested in teaching in Department B are also involved in the FLC. Tim is pleased about how many courses across all the departments have been changed through the change initiative.

Department climate towards teaching mostly remained the same. Tim believes department B's practice of allowing faculty to teach the same course for several years is beneficial for change. Hannah said it was unlikely that the changes she initiated would continue if she were to stop teaching the course. Her colleagues remained uninterested in partnering with her on undergraduate research experiences in the classroom.

Hannah and Tim both said they felt motivated to be involved in the change initiative because of their dedication to student learning. The personal motivation of the participants and the lack of interest from other colleagues may indicate that the environment of the department does not encourage focus on instructional improvement.

B100L. In the beginning years, the other instructor in B100L was not interested in making changes to the course. In the concluding years, the other lecturer, B_L decided to also make changes to her section of the course. Although B_L resisted in the beginning, Hannah feels that her persistence in making her project work is what finally made B_L agree to change her course as well. Hannah says B_L realized that Hannah was going to follow through with her intended changes. Although Hannah was interested in making these changes before the grant was funded, she believes that without financial support from the change initiative, this change would not have happened.

It was difficult to continue to do research in the course because of the weather during the concluding years which impacted the effectiveness of the equipment. It also was challenging to keep the research authentic from year to year. Hannah continued to look for new colleagues who would be interested in working with research with undergraduates. She contacted a colleague to suggest using the equipment for a different course, he said that if the lab coordinator wanted to add a single lab, he was okay with that, but did not want to make extensive courses. Again, colleagues were not feeling motivated to attempt undergraduate research experiences in the classroom.

Hannah invited higher level individuals from the college to semester end student poster presentations. She hoped this would raise the visibility of changes that were being made to high level individuals, who are interested in promoting undergraduate education.

B300. B300 had similar experiences with respect to keeping research authentic. It was challenging to develop new ideas with the limited instrumentation. It was frustrating for students when collecting data was “messy,” or when they did not come up with the best ideas for projects. These problems related to authentic research continued to be a challenge for James.

Social networks. The chair is still believed by the change initiative participants to be important for large-scale change, but his level of participation did not change. The social network analysis indicates that the chair does have many conversations about teaching (Figure 6.5). However, the majority of these conversations are not with the active change initiative participants (who formed a subgroup amongst themselves within the department). Furthermore, many individuals seek out the chair for advice in the classroom. The advice given to these faculty members about teaching is not likely to be influenced by change initiative activities because of the lack of the discussion between the subgroup of participants and the chair.

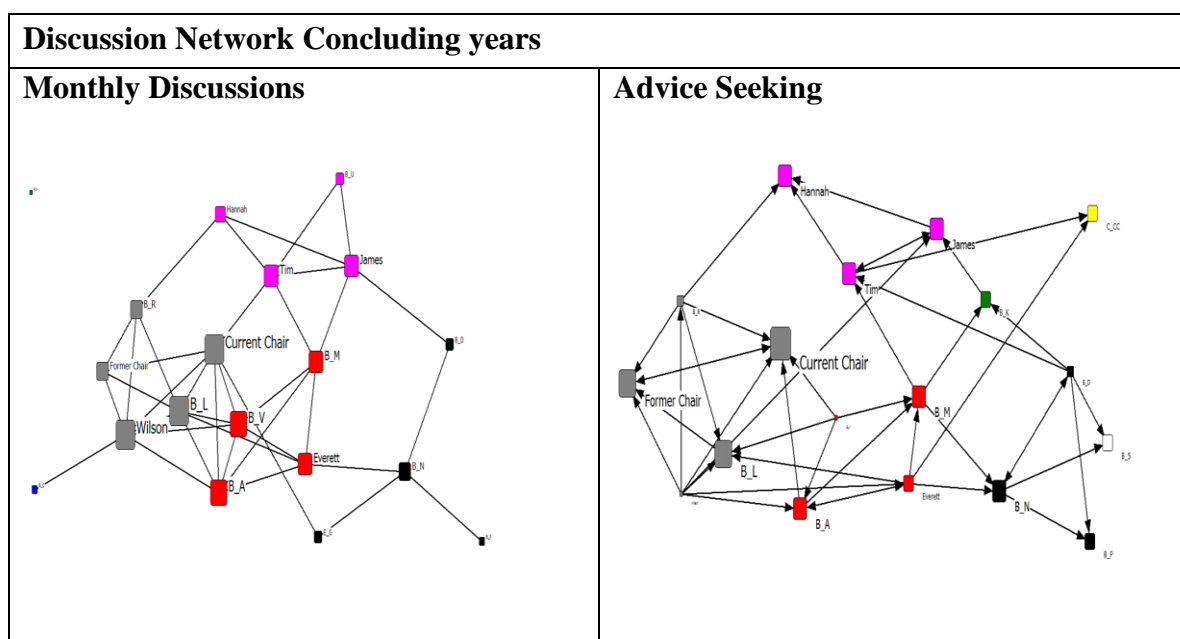


Figure 6.5 The discussion and advice seeking network of Department B in year 3

Department C

Overview

Department C changed six courses (C101L, C111L and C112L, C201L, C301L and C302L). The three hundred level changes were a combined effort of the individuals whose sub-discipline (named sub-discipline C) was addressed in the junior level courses for majors. Department C has 40 members. Fifteen members were involved in the change initiative, including a Co-PI, and two post-doctoral scholars. One member of the department that was active in the change initiative left the department during four years (C_X). Table 6.5 provides a summary of change initiative participants' demographics and the following section presents short biographies of individuals who played a significant role in course changes.

Table 6.5 Individuals who play important roles in department C's change narrative and their role in the change initiative

Name	Title	Change Initiative Role(s)	Sub-discipline C Membership
Barney	Professor	Post-doc advisor (Nancy), Teach C101L	
Marcus	Post-doc	Year 2, FLC member (Laboratory), FLC facilitator (GTALC), C111L/C112L and C201L, C301L/C302L	
Nancy	Post-doc	Year 2, FLC member, FLC facilitator (GTALC), C111L/C112L TA training	
Cedric	Professor	Co-PI, FLC facilitator (Introductory lecture), FLC member (Laboratory/Research), Post-doc advisor (Marcus), C111L, C112L	
Curtis	Professor	FLC member (Laboratory/Research), Teach C201L	
Isaac	Chair	FLC member (Laboratory) C301L, C302L	X
Louis	Assistant Professor	FLC facilitator (300 level lecture) C302L	X
C_O	Professor and Former Chair	Assisted Marcus	
C_DD	Professor	FLC member (300 level lecture)	
C_N	Lecturer	FLC member (300 level lecture)	X
C_R	Assistant Professor	FLC member (300 level lecture)	X
C_KK	Assistant Professor	FLC member (300 level lecture)	
C_K	Senior Lecturer	FLC member (Introductory lecture)	
C_X	Professor	FLC facilitator (Laboratory), Post-doc advisor (Marcus) (left after first year)	X
C_OO	Teaching Laboratory Manager	Attended some FLC meetings (Laboratory)	

Barney. Barney is an education researcher in Department C. In the beginning, he did not believe his courses (C101 and C101L) met the goals of the change initiative. Therefore, in the beginning of the change initiative he was not involved in formal changes. Throughout change he worked with the post-docs (from multiple departments) by inviting them to his weekly education research meetings and by being an advisor to Nancy. He supported the change initiative by attending events hosted by the changed courses in department C.

Marcus. Marcus was the first post-doc in department C for the change initiative. He did not have a background in education. His time was split between education and science research. He worked on changes in the C101L, C201L, and C300 level changes. Many changes were planned before he arrived and he worked on the details of implementation with department members. His time in the department did not overlap with Nancy, the second post-doc for the change initiative. Marcus conducted science education and science research throughout his post-doc.

Nancy. Nancy started working on changes during the fourth year of the change initiative. At this point, the department felt that she should focus on TA training rather than further changes to the laboratory. Nancy worked with the TAs in C101L and C102L. Nancy also split her time between science and education research.

Cedric. Cedric is an education researcher. He is a Co-PI of the change initiative. He facilitated the introductory lecture FLC and attended the laboratory FLC. He also

teaches C101L and C201L. During the fourth year of the change initiative, he went on sabbatical. Jackson (PI) believes his absence acted as a catalyst to encourage other members of the department to become more involved in the change initiative while he was gone.

Curtis. Curtis is in charge of C201L. As a member of the laboratory FLC, he worked to develop C201L into a research module laboratory. The data analysis from his course was used to explore new ideas that he could use in his research group.

Isaac. Early in the change initiative, Isaac became chair of department C. He was involved in rewriting laboratories for sub-discipline C. He believes that inquiry-based activities will be more beneficial than authentic research activities. He has changed his laboratory sections to be more inquiry-based.

Louis. Louis joined the department in the second year of the change initiative. He became involved in facilitating the 300 level lecture FLC, and is currently in charge of 302L. He continued the inquiry-based laboratories that were designed by Isaac.

Setting the Stage

Before the change initiative, the attitude in the department towards teaching was beginning to change. Isaac and C_O describe this change as positive. They said teaching is taken much more seriously than it was ten years ago. They are not able to attribute this change to any one factor, just a general feeling in the department that teaching is

important. They provide evidence based on tenure documents that emphasize the value that the applicant puts on earning teaching awards and on student evaluations. Although they stress that research is still the number one consideration for tenure promotions, they argue that peer and student evaluations are motivators for excellence in teaching. Other members of the department agree that teaching excellence is valued at the department and encouraged by the department chairs. This support is difficult to quantify, but C_K provides an example through course assignment. He says he can tell that the department makes an effort to give him teaching assignments that leave enough time for him to dedicate to instruction improvement.

Department C members have been involved in various activities to improve student learning. Cedric and Barney have taught their courses with inquiry-based activities and active learning techniques. C_K has also been involved in previous projects focused on teaching techniques. In the past, Cedric has shared some information on instructional techniques with other department members. It has always been optional whether individuals want to adopt the changes or not. Teaching has traditionally been thought of as an individual effort in department C.

The Beginning Years

In the beginning of the change initiative, department C was interested in changing the 300 level laboratories and the introduction laboratories for non-majors (C111L and C112L). These beginning changes were started by department members involved in change and Marcus (the post-doc in year two). The 300 level courses cover the topics of sub-discipline C. For these changes, all of the sub-discipline members were involved with

discussing and developing laboratories that could provide students with experiences that mirrored the activities of scientists.

In the beginning of the change initiative, the participants from department C had many concerns about what change was appropriate for the department. One concern was how to ensure student safety while creating more open-ended activities. Several department members claim they cannot change laboratories in department C because granting students who have low content knowledge too much freedom to design and carry out experiments would be dangerous. Along with this safety concern, they felt that other change initiative participants (who were non-department C members, particularly Jackson the PI of department A) did not understand the considerations needed for a successful laboratory in department C. Therefore, the recommendations from other departments were not applicable to department C.

The faculty members felt like a goal of authentic research in the classroom was not possible in department C. This was partly due to safety, partly because of the size of the laboratories, and partly because of how much effort it would take to maintain an authentic research experience. Instead, the participants described the goal of the changes in department C as the inclusion of inquiry-based projects rather than authentic research. This would allow the department to have control of safety concerns and the project could be used from year to year without needing to be revised. Ultimately, they hoped this would cater to the development of undergraduates who could participate in research under a specific faculty member.

Another concern for department C was the training of teaching assistants. This was identified early in the project and was later addressed by assigning the post-doc (Nancy) to work directly with the TAs in C111L and C112L.

C101L. C101L did not change during the first years of the change initiative. This course is mostly taught by Barney, who is a science education researcher. In the past, he was able to incorporate active learning into the lecture section associated with the laboratory. However, as class enrollment has increased, he has found it more difficult to use these techniques. At first, he thought that the course did not meet the goals of the change initiative because it was an accelerated course for students who major in complementary fields. This course takes the two semesters of the introduction course and covers them in a single semester. This makes the addition of any 4 to 5 week projects very difficult because content is covered so quickly. However, in the later years the course was transformed to inquiry-based projects.

C111L and C112L. C111L and C112L are the introductory laboratory for majors in department C. Department C's goal was to change these laboratory courses from "cookbook" to inquiry-based laboratories. The motivation to make these changes was rooted in the desires of the department rather than to meet the goals of the change initiative. In the beginning years, the focus was mostly on the development of inquiry-based laboratories. These courses were the source of many of the safety concerns of the department. They were concerned with giving too much freedom to students in the

laboratory. Safety is part of the reason that inquiry-based laboratories were chosen over authentic research experiences.

C201L. C201L is a laboratory course for majors. Two years prior to the change initiative, department C wanted to develop this course to teach students about scientific processes that they may need to know to take part in a faculty member's research group. The course was intended to recruit and train students to do research. The laboratory was developed by Curtis and C_O. Marcus arrived the summer before implementation and worked closely with Curtis to help implement the change.

The project added to this laboratory is the change in department C that most represents a research module. Students worked on a pilot data for Curtis (the faculty member in charge of the laboratory). Students proposed experiments that they want to complete during the semester. Curtis approves or suggests modifications to these experiments, and then the student performs the experiments in lab. These preliminary analyses are then used by Curtis in his research lab. The change initiative provided money for laboratory equipment (that was also matched by department C) to make this project possible. Curtis believes this change could not have happened without change initiative resources.

C301L and C302L. C301L and C302L are junior level laboratories for majors that cover the topics of sub-discipline C. The members of the sub-discipline knew they wanted to make changes before the change initiative started. They met weekly to develop ideas for the course changes. The sub-discipline members were motivated to develop

ideas quickly when the decision was made to hire Marcus to help with the changes. They recognized that a complete course remodel may have been too much for a post-doc to complete independently. Therefore, they worked together to be ready for Marcus to help with implementation. Isaac describes the changes as a team effort among the members of the sub-discipline.

The projects in C301L were mostly inquiry-based laboratories. The project in C302L is described by Isaac as an extended inquiry-based project. He is careful not to call this project a research module because the results are not of publishable quality. He says technically students are researching information that nobody else has researched, but it is not at the level that it could be published as results.

Social Networks.

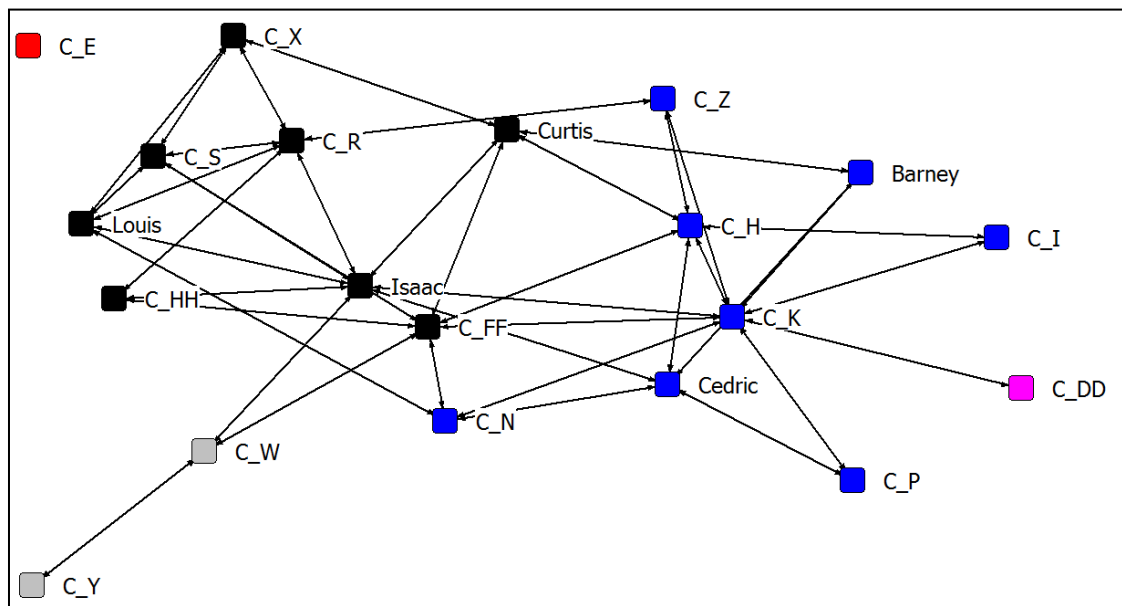


Figure 6.6 Discussion network of department C in the beginning years

In Figure 6.6, the black subgroup has the chair (Isaac) as the main hub of knowledge, while the blue group has the senior lecturer (C_K) who has been involved with the FLCs as the main hub. Both Isaac and C_K's involvement in the change initiative indicates that both subgroups of the department have access to information that the change initiative is promoting.

The social network of teaching discussions in department C had low modularity. This means, although there are two subgroups in the main group of individuals, there are a lot of discussions between the subgroups. The low modularity indicates that department C shares ideas across subgroups and likely has a shared understanding of what they expect teaching to look like in department C. This is supported by the chairs (former and current) indication that peer evaluation and expectations are what have led to excellence

in teaching in the department. The number of discussions in the network, and across subgroups, indicates that individuals do have shared expectations for teaching practices.

The Concluding Years

In the concluding years, department C continued to refine the changes in their courses and also expanded to include C101L. This refinement showed the intention of department C to continue to change beyond the initial adoption of inquiry-based laboratories. In the C111L and C112L this refinement included hiring Nancy to focus on TA training. This shows department C supports substantial change rather than what could have been a change to inquiry-based teaching in name only. This dedication to change was also indicated by several assistant professors of sub-discipline C joining the 300 level lecture FLC.

Department C continued to focus on inquiry as the goal of the change in the laboratories as opposed to five to six week long projects. The exception to this focus continued to be C201L, which was a laboratory that was intended to focus on research.

.

C101L. The changes made by C101L were not necessarily associated with the change initiative. As noted in the beginning years, Barney felt that this course was not appropriate for the changes described by the change initiative. However, C_K describes how the laboratory staff is trying to create more open-ended laboratories in this course. In C101L the changes were mostly made by C_OO, the laboratory manager. The goal of this change was to use the laboratories that already existed and rewrite them to be more inquiry-based. This would allow for the instructors to have some control over the

materials used in laboratory to address safety concerns, but still have the benefits of some direction by the students.

C111L and C112L. The changes in C111L were made before C112L. The laboratories were converted completely to inquiry in the fourth year of the change initiative. At this point, the department C members recognized that the implementation by the TAs had a lot of variation. For this reason, they chose to have Nancy focus on TA training in the laboratories, as well as contribute to the rewriting of the laboratories. She attended the weekly TA meetings in the fall semester and contributed instructional information to them in the spring semester.

C201L. Curtis continued to teach C201L. In the concluding years, Curtis focused on helping students transition smoothly from introduction material to performing research activities. In the future, he believes keeping the laboratory project up-to-date will be a challenge. It will require further funding from the department or external sources.

C201L was intended to be a research skills course; therefore, the influence of the change initiative on the direction of the laboratory may have been minimal. The course was always intended to be research-focused for honor students. Nancy is concerned that the success of 201L may not be recognized for this reason. This may mean that assessment of C201L will not be useful for motivating change in the rest of the department. Furthermore, no formal assessments of the influence of the course on students' involvement in faculty research laboratories have been made. Department C intended to have this course prepare students for work in faculty research groups. This

type of assessment may be the most influential in convincing the members of department C that research projects in the laboratory are successful.

C301L and C302L. The changes in C301L and C302L continued to be based on team cooperation between the faculty members of sub-discipline C. The changes in C301L were lead by Isaac, while Marcus focused on the extended inquiry-based project in C302L. Isaac feels that more resources could have made a significant difference in the outcomes of the change (as opposed to more resources only leading to minimal gains). He felt pressured by the change initiative to continue to expand the changes to new areas, while he would have liked to spend more time refining the changes that were already made.

The communication of these changes to the rest of the department was limited. Some members were completely unaware of the changes. For example, both Curtis and Nancy were unaware of the changes to these courses. Curtis said he expected that most faculty members probably did not realize changes were being made to these courses.

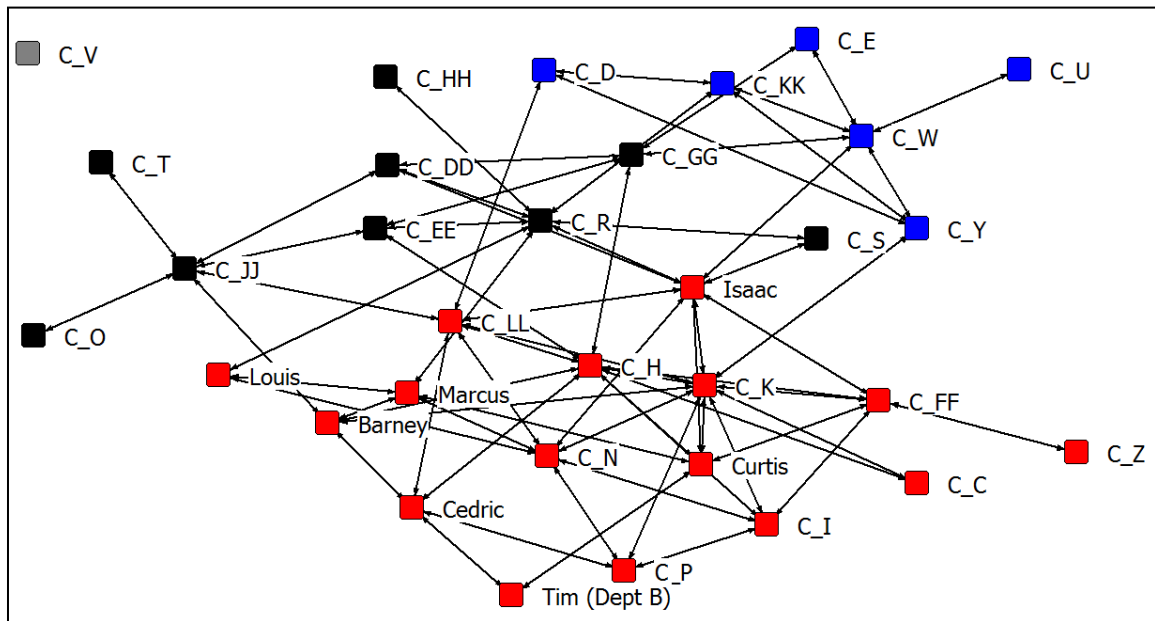


Figure 6.7 The discussion network of department C in the concluding years

In the concluding year's discussion network (Figure 6.7), department C continued to have low modularity (many connections across subgroups) and few subgroups. This is a sign of a shared understanding of teaching practices expectations in the department. However, in the concluding years, Curtis and Nancy indicated that communication about change initiative activities was low. This may mean that while discussions about teaching are occurring, they are not discussions about adopting new material. The exception would be within the sub-discipline C group that is working together on changes.

Department D

Overview

Department D has 45 members. These members include three post-doctoral scholars. Two of these post-docs were hired by the change initiative. The third post-doc was interested in creating a research module for a project associated with the change initiative. (She was partially supported by the change initiative.) The change initiative influenced changes in five of the courses that are taught by department D (D202, D202L, D204, D204L, and D301L). Three of these changes were in laboratories; two of these laboratories had associated lectures, which were also changed. One of these lectures is a large (~300 students per section) introductory lecture. In this course, nine instructors were involved in making changes to active learning in their lectures. This change had the most impact on students who took courses from department D. Table 6.7 provides an overview of the participants of department D. The following sections are short biographies of key individuals from department D, including the cohort of individuals who worked on the large lecture course.

Table 6.7 Individuals who play important roles in department D's change narrative and their participation in the change initiative

Name	Title	Change Initiative Role(s)
Faith	Chair and Professor	Co-PI, Post-doc advisor, FLC member (Lab, D & E, D), Teach D202
David	Professor	FLC member (D & E), FLC facilitator (D), Summer Institute, Teach D202
Nathan	Associate Professor	FLC member (D & E, D), Summer Institute, Teach D202
Mallory	Senior Lecturer	FLC member (Lab), Teach D204/D204L
Vivian	Lecturer	Teach D204/D204L
Brad	Assistant Professor	Teach D301L
Anna	Post-Doctoral Scholar	FLC member (all), GTALC, D202/D202L, E201/E201L, D301L
Adele	Post-Doctoral Scholar	FLC member (D), GTALC, D202/D202L
Candace	Laboratory Coordinator	D301L
D_S	Professor	FLC member (D & E, D), Teach D202
D_E	Senior Lecturer	FLC member (D & E, E), Teach E201
D_H	Associate Professor	FLC member (D & E, D), Teach D202
D_CC	Professor and Dean	FLC member (D & E)
D_HH	Professor	FLC member (D & E, D), Teach D202
D_RR	Associate Professor	FLC member (D & E, D), Teach D202
D_WW	Post-Doctoral Scholar	D301L
D_B	Associate Professor	FLC facilitator (D & E)
D_EE	Professor	FLC member (300 level lecture)

Faith. Faith began the project as a Co-PI and a faculty member who was new to teaching D202. However, she was soon appointed as the interim chair of the department. After a year, she continued as the chair of the department. Before she became chair, she taught D202 and participated in the FLCs (Lab, D & E, and D). She also acted as faculty

advisor to the post-doctoral scholars hired by the change initiative. Faith continues to promote the change initiative goals through acknowledgement in faculty meetings and encouraging new faculty to be involved.

David and Nathan. David and Nathan are two of the instructors of the D202 course. They also attended a summer institute at the beginning of the change initiative. This institute was a source of inspiration and knowledge for David and Nathan. They shared their experiences with the FLC and the faculty through a lunch time presentation.

Mallory. Mallory is a senior lecturer who went into phase retirement during the change initiative. She had been involved in D204/D204L for a number of years. She attended the Laboratory FLC and made changes to D204L.

Vivian. Vivian is the lecturer who was hired to replace Mallory when she went into phased retirement. She is working on extending the changes that were made by Mallory in D204/D204L. The TAs who had taught the course with Mallory before she retired are assisting Vivian in designing and implementing further changes.

Brad. Brad taught D301L for the first time during the concluding years of the change initiative. He continued the changes that were made by Candace (laboratory coordinator), D_WW (Post-doc from a related science department involved with D301L research), and Anna. He felt like he did not have time to attend FLC meetings, especially because he was still an assistant professor.

Anna. Anna was the first post-doctoral scholar hired by the change initiative. She worked closely with the D & E FLC. She helped develop modules for both D202 and E201. She also was involved with the changes to D301L. Anna helped facilitate the first GTALC. Anna had some background with education research prior to working on the change initiative, although her main focus had been science research. She conducted both science education and science research.

Adele. Adele was the post-doctoral scholar hired by the change initiative after Anna left. She focused more intensely on the D FLC and the D202/D202L changes. She also was involved in the GTALC. She conducted both science education and science research.

Candace. Candace is the laboratory coordinator who was involved in the beginning changes to D301L. At first, she was resistant to change. However, eventually she decided to make changes. She worked closely with D_WW to pilot the changes in the course, but left the department in the middle of the change initiative.

Setting the Stage

Department D and department E are closely related. Between the two of them, they have a single undergraduate major. This is why the D & E FLC targeted members from department D and department E. These were primarily the instructors for the E201 course and the D202 course. Students take these courses in consecutive semesters. The departments collaboratively staff all of the courses; therefore, the chairs also meet

frequently. This arrangement is only ten years old. The chairs believe that having this context (that requires communication and coordination between departments) has helped department members become accustomed to change. Furthermore, the chairs explain that the most recent budget has helped identify undergraduate education as an important funding source for both departments.

The departments have a teaching-based lunch seminar. These are informal meetings that happen occasionally throughout the school year where education-focused faculty members present teaching-related material. This lunch seminar is organized by Wade (of department E).

In department D, several faculty members have been interested in various teaching techniques. For example, D_Z and D_H have both expressed interest in using active learning in their classroom prior to the start of the change initiative. However, promotion and tenure considerations have been based primarily on research ability.

Prior to the change initiative, department D had undergone some significant changes in instructors. This was especially true for D202. Traditionally, this course had been taught by senior members of department, who were less focused on research. However, these senior members retired and this meant that research-intensive instructors would now be teaching this large-lecture course. The change initiative started at the same time as these departmental changes. Many of the participants from department D became involved in the change initiative because they wanted support in teaching a course for the first time.

In the past, department D has relied on person D_B for education concerns. She has worked on a few education projects and attended some education-focused

conferences. She facilitated the D & E FLC in the first year of the change initiative. However, she was not teaching any of the courses that were undergoing changes. Her involvement decreased as the years continued because of the focus on specific course changes.

The Beginning Years

In the beginning years, department D and department E were involved in a joint FLC (D& E) to address the large introduction course (for majors and non-majors). The departments also wanted to change the associated laboratories. In this FLC, the main goal was creating shared learning objectives among instructors in the lecture sessions. The members of department D felt especially frustrated by the slow progress of the D & E FLC (arguing that even at the end of the year, no shared learning objectives were identified). Towards the end of the first year, the FLC had begun to spend much of their time in groups that were divided according to which course the instructors were teaching. This led to a split of the FLC in the following years (D FLC and E FLC) to address each course separately.

The members of department D who taught the D202 course felt particularly motivated to be productive in the FLC because many of them were teaching the course for the first time. The chair (D_LL in the first year) attempted to set up a structure within the department of moving individuals in and out of the introduction courses. He felt this would lead to a community of individuals who had taught the course and were dedicated to the new way of teaching the course. D_LL argued that this community would be more successful in creating change than trying to tell faculty members how to teach. He

believes if the FLC leads to changes in the course catalog this would be likely to influence how the course was taught in the future.

According to the leadership of the change initiative, some resistance to change existed in department D laboratories. The individuals who had been teaching or coordinating the TAs of the upper level courses (D204L and D301L) were involved in the change initiative but made minor changes in the beginning years. Both of the instructors of these courses felt like the work they were already doing was meeting their needs. However, the Faith (Co-PI) and Jackson (PI) felt that these laboratories could benefit from even more change.

In the beginning years, members of the change initiative from department D recognized the importance of assessment. They wanted to assess their changes in order to ensure that they were improving the experience of students, and they wanted to use assessment to convince others within the department and the college that these changes were important. Anna (the post-doc) was in charge of most of the assessment in the early years.

David and Nathan also attended the summer institute in the beginning of the change initiative. Both David and Nathan felt that attending the summer institute was a great way to be introduced to instructional techniques. Nathan and David shared the information that they had learned at the summer institution with the FLC. Faith identified their experience as an important source of expert knowledge during FLC meetings.

One of the challenges facing department D was increases in enrollment without an associated increase in resources for teaching courses. This influences the implementation

of changes. For example, Nathan described how one of his main challenges was crowd control while trying to implement active learning techniques.

The main changes in the beginning years focused on D202. D204L and D301L had some changes that were only considered minor by the leadership of the change initiative. D202L did not become a focus of changes until the concluding years.

D202. The large lecture introductory course was the primary focus of the department changes in the beginning years. Individuals who taught the course were motivated to use the resources of the change initiative because they had not taught the course in the past. The department also chose to assign individuals to co-teach the course. Rather than teaching a section individually, two individuals taught a single section. Each individual was responsible for half of the lectures. They switched back and forth throughout the semester.

Co-teaching in D202 was beneficial in some situations and challenging in others. The first benefit was that nine individuals were involved in making changes to the course. Nine of the ten instructors were involved in the D FLC and worked to change the course. (The tenth instructor was near retirement and did not want to change his teaching strategies.) Traditionally, the course had been lecture-based (the instructor spoke and students took notes), the new instructors worked together to implement active learning techniques into every lecture (clickers, group discussion, etc.). The FLC decided that each instructor would create modules in their area of expertise that included engaging examples and active learning strategies. Then, the instructors would share their modules with one another, so that all of the course lectures had been written to include active

learning. Co-teaching also achieved what D_LL had hoped, many professors experienced what it was like to teach introductory course and participate in the FLC.

In some situations co-teaching became a challenge. If the teaching styles of the instructors were significantly different, the students tended to favor one instructor over the other. This was evidenced in student evaluations and in students' willingness to participate in activities during the course. Faith explains that peer evaluations and FLC participation was important for counteracting these negative reviews. The other faculty members knew that the individual with the poor reviews was working hard on the course and attributed the poor reviews to the co-teaching and not to the individual. This also helped build community among the instructors.

In the beginning, Anna developed the D202 modules and planned the assessments. She found this to be challenging because it required coordinating the teaching strategies of so many faculty. However, the FLC members felt Anna's expertise was important source of support for the change. This included her knowledge of education literature and her work in developing modules.

Because many of the instructors were new to the course, Faith believed that inertia was not a problem. Individuals had not been set in their ways of teaching the course. However, FLC members acknowledged that implementation of the active learning was challenging because they were new to both active learning techniques and teaching large-lecture courses. This may have been a confounding factor in assessing the success of the active learning techniques.

D204 and D204L. D204 and D204L are smaller courses that were taught by Mallory in the beginning years. Mallory attended the laboratory FLC. She had her students create six proposals of research throughout her course, and then they completed one of their proposals as a project. She felt like being part of the FLC was beneficial for her to articulate the ideas she had for including scientific practices into her course. However, the leadership of the change initiative did not feel Mallory's changes met the expectations of the goals of the initiative.

D301L. In the beginning years, Candace, Anna, and D_WW worked on changes in D301L. Candace was the laboratory coordinator for the course. Faith reported that Candace was not happy that the department was trying to change the course that she had spent a lot of time implementing in its current state. To ease Candace's fears, Faith suggested that first they try to incorporate higher level thinking into laboratories before considering a longer project. Candace worked on these changes and eventually also helped develop a longer research-based project with D_WW (a post-doc from a different department).

While making changes, Candace became unhappy with other aspects of her position. She frequently would share her displeasure with faculty members in the department. By the end of the beginning years, Candace chose to leave her position with the department.

Social networks.

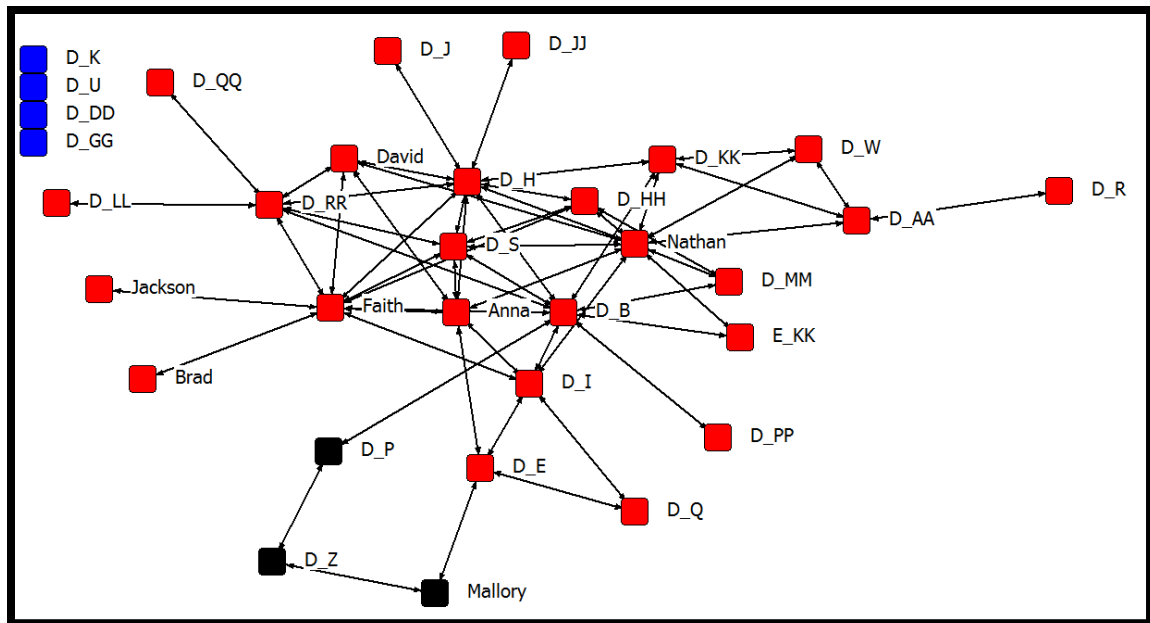


Figure 6.8 Social network of department D in the beginning years

In the beginning years, department D had low modularity (Figure 6.8). This means that subgroups were not well-defined in the network. Many of the central individuals are also members of the D & E FLC and the D FLC (Anna, Nathan, David, D_H, D_S, and D_HH). Exceptions to this are D_E and D_CC. D_E teaches the introductory course housed in department E, and D_CC is a dean that had anticipated a return to teaching, but never was able to teach the course. The frequent discussions of the FLC members provide evidence that D_LL's goal of building a community of individuals within the network through participation in D202 was occurring.

The Concluding Years

In the concluding years, the department continued to focus much of its energy on transforming D202. This goal was also expanded to focus on improving the laboratory

courses D202L, D204L, and D301L. D204 never did undergo specific changes, but because it is so closely associated with D204L it is included with those changes.

Turnover in instructors continued to be an important catalyst for change. In D202L, another retirement allowed Faith to bring in a new faculty member who was encouraged to make changes. In D301L, turnover included Candace's exit from the department and the assignment of the course to Brad, an assistant professor. For D204 and D204L, Mallory went into phased retirement and Vivian was hired to replace her. Vivian was encouraged to make changes in the laboratory with the help of the teaching assistants that had taught the course before.

One of the major changes to department D was Faith's appointment as department chair. As department chair, Faith became even more involved in promoting and acknowledging individuals involved in improving instructional practices. She did this by encouraging newer instructors to become involved in the change initiative (Vivian and Brad) and by recognizing teaching efforts in faculty meetings. Members of department D know that Faith values efforts to improve instruction. Nathan credits her with creating a culture where teaching is valued by the department members.

Faith continued D_LL's practices of moving instructors in and out of the introductory course. She also believes that this builds community among the department members. She believes that teaching the course helps department members value the effort it takes to teach introductory courses.

A positive change in the department noted by Faith was the number of department presentations that have been on teaching. She said that the department has a history of faculty presenting their research to keep others up to date on their activities and to create

opportunities for collaboration. During the change initiative, four people have chosen to make presentations on teaching activities. In the history of these presentations, Faith says only one other presentation has been on teaching. She believes this is a sign of the changes in the department.

D202. After Anna left the department, Adele was hired. Her focus was on helping transform the D202 course. She described her job as being a resource for the instructors in D202 and a translator of ideas and goals from the PI to the department. She felt some frustration in this role because she was not able to tell department members to change but instead had to encourage them from a position that had no authority. Adele continued the assessment of changes in D202 and attended many of the lectures. She believes that the lectures do successfully implement active learning, although some instructors are better at using the techniques than other.

In the concluding years, the instructors in D202 felt less frustrated with the productivity of their FLC. They benefited from working independently of the department E faculty. However, D_H also reported that discussions across departments greatly decreased without the D & E FLC. He felt like this was a weakness, but productivity was his main priority with respect the FLC. The instructors in D202 continue to use active learning and to work together in the FLC to improve their courses. In addition, some new instructors began teaching D202 and also became involved in the FLC and in using active learning techniques.

D202L. The plan in department D was to focus on D202L after the second year of the change initiative. This change was also facilitated by the retirement of faculty member that had been in charge of the laboratory for years. Faith brought in D_QQ to take charge of the laboratories. She said at first he was overwhelmed with this responsibility and wanted to continue the laboratory without changes. However, Faith continued to encourage him to make changes, along with E_JJ (laboratory staff member). During the fourth year of the change initiative, D_QQ was interested in including inquiry-based laboratories in D202L.

D204/D204L. In D204 and D204L, change was facilitated by the retirement of Mallory and the hiring of Vivian. Vivian was first starting to make changes during the fourth year of the change initiative. According to Faith, Vivian was overwhelmed by the new responsibility of the course that had been taught by Mallory for so many years (and who was a favorite instructor among students). Faith encouraged Vivian to use the TAs as a source of knowledge for changes in the course. The TAs formed a learning community with a lead TA and took responsibility for transferring and improving the course. The TAs assisted Vivian in identifying areas where the course could be modified to be improved. This allowed Vivian to benefit from the previous course taught by Mallory and to expand on changes as a new instructor in the course. Faith is optimistic that this will lead to inclusion of a research project in the course, while Jackson is concerned that it is too early to determine if change will occur in D204/D204L.

D301L. In D301L, after Candace left, Faith brought in an assistant professor (Brad) to continue the changes in the course. Brad was excited about including D_WW's research project into the course. However, he also had some concerns. First of all, he was worried that in order to complete the research project, the beginning laboratories were too directed. A lot of material had to be included in the earlier laboratories in order for students to have enough process and content knowledge to complete the research project in the last five weeks of the course. Brad discovered that students found it difficult to adjust from guided laboratories to the open-ended research. Furthermore, to cover all of the content in the beginning weeks meant that the laboratory was no longer synced with the lectures. This meant that content had to be covered in the laboratory so that students could understand what they were doing.

With twenty sections (each with approximately twenty students), Brad also found it challenging to coordinate the materials and the set-up for the laboratory. The logistics of keeping students on track while also allowing them to experience the trials of authentic research were challenging. If the students were given too much freedom, their mistakes may stop them from being able to complete the project. However, reducing this freedom decreased the authenticity of the laboratory. Brad struggled with finding balance between trying to be authentic, engaging students in activities, and managing all of the sections of the course.

One of the major portions missing from D301L is assessment of what aspects are working well and what aspects should be changed. Brad recognizes that more assessment is necessary but he lacks the education research knowledge and the time to do the proper

assessment. Brad also does not attend the FLC meetings because he feels that as an assistant professor, he needs to focus more of his time on his research.

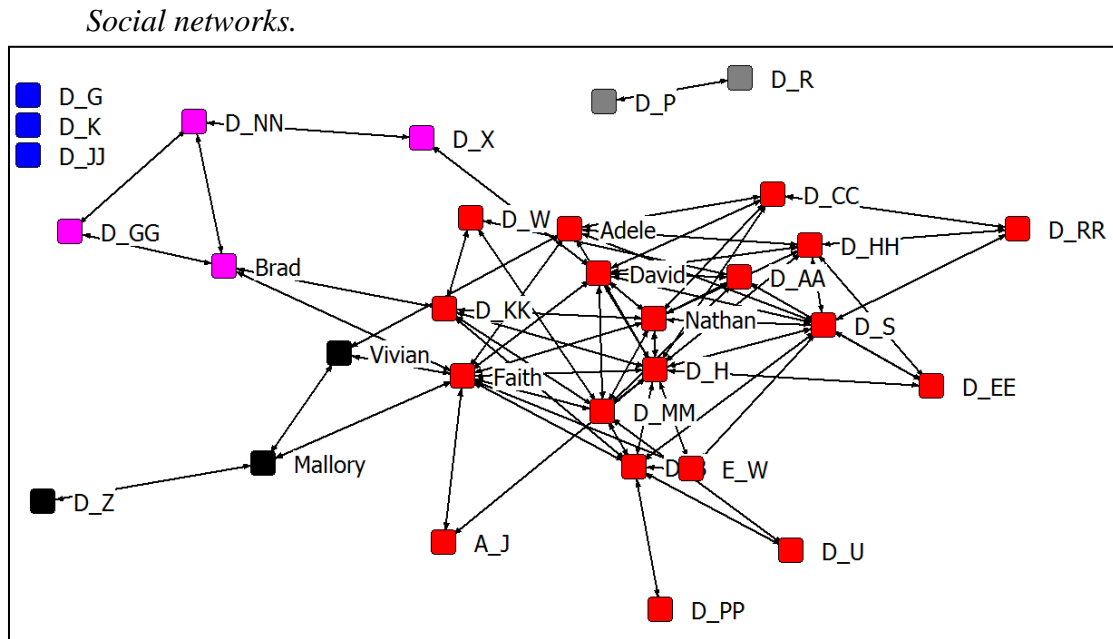


Figure 6.9: Discussion network of department D during the concluding years

The discussion network remains relatively unchanged (Figure 6.9). The subgroups are still not well-defined. This could indicate that the community feeling in the department exists. However, an assistant professor (D_W) in the department claimed that support was available for instructors of D202 but not for anyone else. This may mean that department D needs to put more effort into expanding their community to include non-D202 instructors.

Department E

Overview

Department E has 45 members. Two of the change initiative post-doctoral scholars were based in department E. A third post-doc, Anna from department D, also worked with department E in the first year of the change initiative. Department E is the only department that did not include a Co-PI or the PI. Most changes occurred in a laboratory course of department E (E201L), but the change initiative also targeted two other courses (E201 and E302). Table 6.9 provides an overview of the change initiative participants from department E. The following sections are short biographies of key individuals from department E.

Table 6.9 Individuals who play important roles in department E's change narrative and their participation in the change initiative

Name	Title	Change Initiative Role(s)
Wade	Assistant Professor	FLC facilitator (D & E, E) FLC member (Lab), Post-doc supervisor, Teach E201, E201L
Paul	Assistant Professor	FLC facilitator (Lab)
Kelly	Post-Doc	GTALC, Develop E201L
Rose	Post-Doc	FLC member (E), GTALC, Integrate E201/E201L, Assess E201L
E_AA	Assistant Professor	FLC member (D & E), Teach E201
E_V	Professor	FLC member (D & E), Teach D202
E_BB	Adjunct Assistant Professor	FLC member (D & E), Teach E201
E_LL	Associate Professor	FLC member (D&E), Teach E201
E_M	Adjunct Associate Professor	FLC member (D & E, D), Teach D202, D202L
E_F	Assistant Professor	FLC member (Lab), summer institute, Teach E302L
Ellen	Laboratory Coordinator	E201L
E_S	Professor and Chair	NA

Wade. Wade has been dedicated to improving undergraduate education for most of his career. After achieving tenure, he chose to focus on teaching rather than research. He has published some education research articles, and still does scientific research but he focuses on improvement of undergraduate education. He is a member of the curriculum committee for the undergraduate major sponsored by department E and D. He also supervises the second semester introductory laboratory (E201L) that was changed. Wade has also partnered with other education researchers at the university to improve his teaching and has participated on education-focused grants. Wade facilitated FLCs (D & E, and E) and was an FLC member (Laboratory). Wade is identified by other members of department E as a talented teacher.

Paul. Paul is an assistant professor in department E. Prior to the beginning of the change initiative Paul had been involved in teaching a research experience for upper level majors in a course. This involvement brought him into contact with Jackson (PI). Jackson asked Paul to facilitate the Laboratory FLC. Despite being discouraged from being involved in a program that would not be very helpful for attaining tenure, Paul chose to become involved and has greatly valued the experience. Paul is particularly proud that two of his science-focused graduate students have included education aspects into their dissertation projects.

Kelly. Kelly is the first post-doc who was hired to work directly with department E. Her main focus was creating an inquiry-based project to include into E201L and assessing the project. For this project she worked closely with Wade and Ellen.

Rose. Rose joined department E as a post-doc after Kelly had left. Rose's project was completion of the assessment begun by Kelly and coordinating the E201 and E201L courses. During the fourth year of the change initiative, she attempted to create communication between the instructors of E201 and the teaching assistants of E201L through a weekly newsletter.

Ellen. Ellen is the laboratory coordinator for department E. She has worked closely with Wade and the post-docs on the changes in E201L the introductory laboratory. She is in charge of training TAs and managing the laboratory.

Setting the Stage

Department E and department D share the same undergraduate major. The departments have a joint committee dedicated to the shared major. These individuals (Wade, E_KK, E_X, D_H, and D_P) have weekly meetings to discuss teaching. Wade and D_H are involved in the change initiative while the other members are not. In department E, the chair provides time in faculty members for this committee to discuss teaching-related issues. This is the primary source of teaching discussions within the department.

Recently in department E enrollment has increased. This has also coincided with budget reductions. This has had two impacts on the department. First, the chair feels like there is less money to use to support teaching efforts. Second, the department has realized that a significant amount of their funding is from undergraduate tuition. Wade believes this has elevated the importance of teaching. The department members have realized it will be important to ensure they are providing a quality education to their undergraduate students.

In the department, Wade is recognized by many faculty members as being a source of teaching expertise. He is respected by his colleagues for his talent and dedication. Wade's focus on teaching has likely prevented him from having a prominent research program and from promotions beyond associate professor. For this reason, Wade feels that many of his colleagues are puzzled by his dedication to teaching over research. However, he is motivated to continue to focus on teaching because of the positive results he sees in his students.

Another example of focusing on research-based instructional practices in department E is the upper level course that was taught by Paul and E_MM before the change initiative began. This course involved inquiry-based laboratories and a longer, open-ended project at the end of the course. However, Paul was assigned to a different course at the beginning of the change initiative and this particular project did not continue after he changed assignments.

The Beginning Years

The chair of department E says he is supportive of the change initiative. He trusts the Co-PIs and the faculty of the department to make the changes and generally is removed from the details of the effort. He shows his support through offering time at faculty meetings to discuss change initiative activities (although it is unclear if this actually happens, but he is open to the idea) and provides funding support when the department budget allows him too. For example, the department helped support E_F's trip to the summer institute.

In the beginning years the E201 lecturers were involved in the D & E FLC. This FLCs goal was coordination between the semesters and sections of the introductory course. Wade felt concern that focusing on changing for the sake of changing runs the risk of losing some positive aspects of the course. He was worried that some of his effort towards the introductory courses will be lost just so that the department can make changes.

E201. E201 instructors were invited to the FLC in the first year of the change initiative. Wade acted as co-facilitator of this FLC along with D_B of department D. The goal identified by the FLC was the coordination of the efforts in E201 and D202 and the development of shared learning objectives. With respect to E201, Wade felt like the FLC was largely unsuccessful in developing shared learning objectives. He said a benefit of the FLC was developing a feeling that his focus on Nature of Science was not outside of what the other instructors felt was important for the course. Before the FLC, he thought he was the only person interested in Nature of Science concerns and active learning. However, after the FLC he at least felt that the awareness among the instructors was increased, but no real changes were made.

In the second year, the D & E FLC split into two separate FLCs. In department E, the interest in the E FLC was limited. The FLC members felt frustrated by the lack of productivity in the first year and were not willing to dedicate time to a second year of meetings. However, Wade kept all of the instructors on the email list to try to involve them in the information that was being shared in the FLC. As a facilitator of the FLC, Wade shared some of his lectures with his colleagues; however, he is unsure if any members used his resources. In general, he does not feel that his teaching was impacted by what happened in the FLC.

Jackson (PI) believes that part of the reason the E FLC had a difficult was the difference in expectations for the course between himself, the instructors and Wade. First, Wade felt generally happy with how he taught his course (active learning, engaging) and did not feel the FLC had impacted his teaching. Second, many of the other instructors (but not all) felt that the main focus of the course must be more content-based and not

focused on critical thinking (as Jackson thought it should be). Jackson felt that until these goals were reconciled the FLC was not likely to be successful.

E201L. Wade was also involved in changes in *E201L*. He attended the Laboratory FLC and worked with Ellen and Kelly on changes. In the beginning years, Ellen and Wade expressed concern that inquiry-based projects were considerably different for their science than they were for the other science departments. They felt pressure to make changes that matched what other science departments were doing, even though these changes were not appropriate for their discipline. Ellen felt that part of her job as laboratory coordinator was listening to what faculty hoped to do in the laboratories and helping them realize what changes were possible and those that were logistically impossible. Wade and Ellen have a close working relationship and generally agree on what can and should be done in *E201L*.

Instead of making changes similar to other Laboratory FLC members, Wade identified a particular topic that he felt was essential to understanding his discipline and underrepresented in most introductory courses. He then decided that this topic should be the focus of changes in *E201L*. When Kelly joined the change initiative, he encouraged her to focus on creating and assessing an inquiry-based project that addressed the topic. Wade felt that he would likely have made these changes without the help of the change initiative, but the initiative gave him extra help by providing support for developing the project and especially for assessing the project. He feels that without the change initiative he would not have had time to assess the project.

claim. It is likely that members of different subgroups did not have the same opinions on teaching.

Wade, E_KK, E_X, (the E & D major committee members) and Ellen (the laboratory coordinator) are members of the subgroup that is speaking with the chair about teaching. This indicates that the major committee does have some influence on the information that is shared with the chair. E_S dedicates time in faculty meetings to discuss the needs of the committee. This communication between the chair and the committee is represented in the social network.

The Concluding Years

The changes in department E during the concluding years focused on E201L and restarting the E FLC. In E201L, two aspects contributed to the ability to change. First, one of the senior faculty members that had worked on the laboratory course retired. This allowed Wade and Ellen to have more freedom to make changes to what was traditionally taught in the laboratory. Second, the department also hired individuals to help with the other laboratory courses (other than E201L). This gave Ellen more time to focus on implementing the changes in E201L.

Rose also joined the department as a post-doc in the concluding years. Her goal during the fourth year of change initiative was restarting the E FLC and syncing E201 and E201L. To align the two courses, she attended the lectures and the laboratories. From this attendance, she was able to gain an understanding of the current states of the different sections. She compiled this information into a weekly newsletter that was sent to the instructors and TAs. This newsletter gave a summary of the current state of the sections

(topics covered, test dates, laboratory topics, etc.). The newsletter also included some information on active learning techniques that instructors could use. The goal of this newsletter was to facilitate communication between the different sections. The hope was that communication was the first step to aligning the two courses and the sections. Rose felt concerned about how well this would work because she had no formal power to use to influence faculty members to change.

Jackson encouraged Rose and Wade to restart the E FLC. Rose felt this was a difficult task because people were frustrated with the way the E & D FLC's lack of productivity and E FLC's lack of involvement. However, some new assistant professors who had not been involved before showed interest in restarting the FLC. Wade felt that if the FLC had a more specific goal it could be successful. He suggested that the FLC should focus on choosing a new textbook for E201 (a task that needed to be completed with or without the FLC). The E FLC was restarted but still had a difficult time producing results.

E201. The FLC and the instructors in E201 continued to have a difficult time producing results. Jackson feels that part of the problem is a difference in opinion about what E201 should attempt to do. Some of the instructors feel it should be used for learning vocabulary and content. In contrast, Jackson would like to see the E201 include scientific thinking into the course. At the end of the change initiative, E201 had remained relatively unchanged. Wade uses active learning and stresses Nature of Science in his section. Jackson would like to see these characteristics represented in other sections of

E201. The use of active learning and inclusion of Nature of Science learning objectives among the other instructors varies considerably.

E201L. In E201L, Wade and Ellen were successful in restructuring the course with the help of Kelly's inquiry-based project. Rose is continuing the assessment that Kelly started and helping refine the changes. Preliminary results from the assessment indicate that students have fewer misconceptions at the end of course than they did at the beginning. Anecdotally, Wade and Ellen feel that the changes are having positive impacts on the students. Ellen reports hearing from the TAs, that students seem to be more engaged in the course after it changed.

E302L. After E_F left the department, E302L was taken over by E_OO, an assistant professor in the department. E_OO chose to continue teaching the course with the changes that E_F added. She has had conversations with Jackson about her implementation of the project and her excitement to continue the changes in the future.

Social networks.

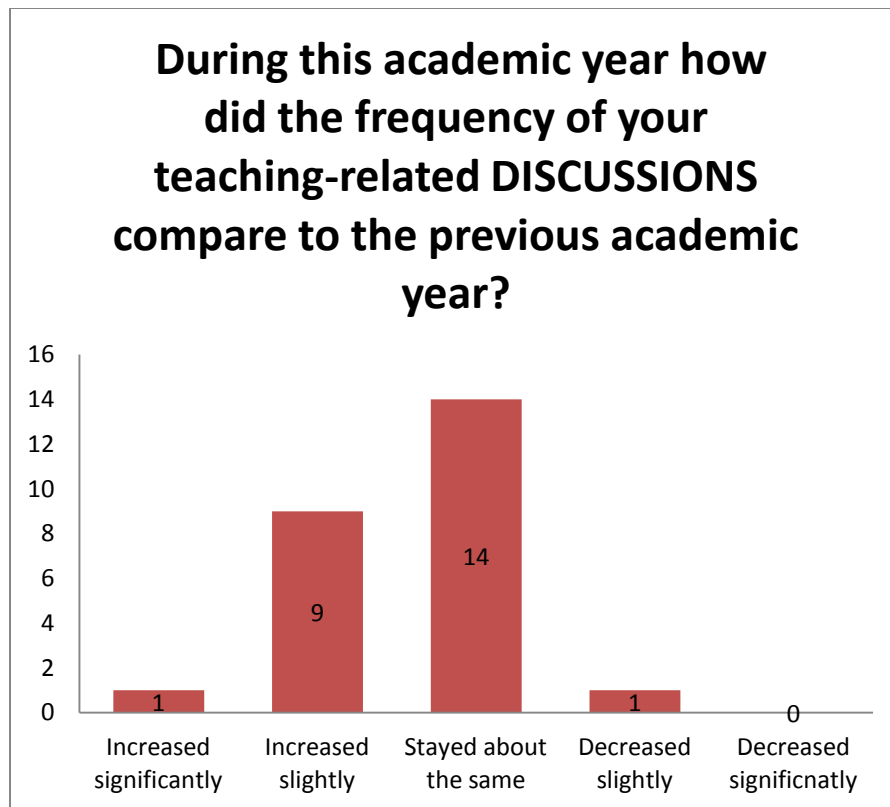
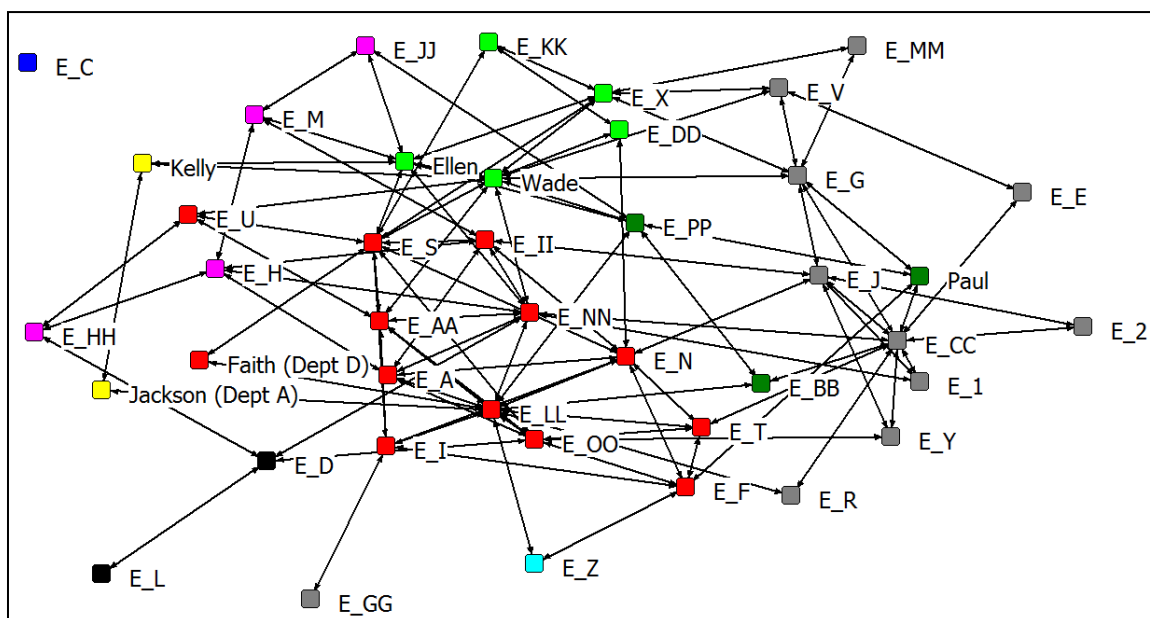


Figure 6.11 Change in frequency of discussions about teaching reported by individuals in department E on the social network survey



295

matches the chair's expectation for what he thought the grant would change in the department. He predicted that conversations would increase and the department would develop an awareness of education concerns. The social networks indicate that the conversations about teaching have increased in department E.

The advice network of department E shows how much the department relies on Wade for his education expertise (Figure 6.13). Many people identify Wade as a successful teacher in the department and the advice networks shows how influential he could be on the teaching practices in the department. However, Wade reports that this actually happens relatively rarely. Jackson feels that department E's reliance on Wade for education concerns may be inhibiting their ability to take ownership of education changes.

REFERENCES

- POGIL. (2014). In *POGIL: Process Oriented Guided Inquiry Learning*. Retrieved June 11, 2014, from <https://pogil.org/>
- Weaver, G. C., Russell, C. B. & Wink, D. J. (2008). Inquiry-based and research-based laboratory pedagogies in undergraduate science. *Nature Chemical Biology*, 4, 577-580.