Department-Level Instructional Change: Comparing Prescribed versus Emergent Strategies

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ABSTRACT

Academic departments are thought to be highly productive units of change in higher education. This paper investigates department-level instructional change via case studies analyzed with two change frameworks. One framework embodies prescribed change, emphasizing leader actions. The other framework embodies emergent change, emphasizing participants' responsibilities. Analysis identified successes and missed opportunities. The results provide guidance on how change agents might create vision, motivate participants, build momentum, and institutionalize change. Through familiarity with multiple change frameworks, a change agent can plan change initiatives that best fit with the local goals and context, thus increasing the likelihood of success.

INTRODUCTION

There have been many recent calls for the improvement of higher education. One issue that continually garners attention is the need for quality undergraduate science, technology, engineering, and mathematics (STEM) educational experiences that improve student learning outcomes (National Science and Technology Council, Committee on STEM Education, 2013). Doing this requires structural changes, such as changes in reward systems that reflect the value of effective instructional practices (Seymour 2002; DeHaan, 2005). Change initiatives that address these calls have taken the form of prescribed initiatives (e.g., strategic planning; de la Harpe and Thomas, 2009), emergent initiatives (e.g., Gibbs *et al.*, 2006). Yet little guidance exists to help change agents, anyone who hopes to promote change, successfully organize change initiatives.

In this paper, we describe how the process of change occurs from the perspective of two change frameworks. Each framework provides a perspective on how change agents might structure activities, understand challenges, and enact solutions to fit their context. We use case studies from an institution-based change initiative involving five STEM departments to illustrate these perspectives. We argue that change agents will be more successful if they match their change strategies to their context by being able to think about the process of change in more than one way. To accomplish this, we have not sought to create a "recipe" for change but rather to identify a set of strategies that facilitate change and a set of guidelines that change agents can use to choose appropriate strategies from this set given their context. We begin by discussing the context of the five case studies.

CONTEXT: FIVE STEM DEPARTMENTS

The case studies are five departments at a research, doctorate-granting university involved in a grant-funded change initiative. Faculty members from four of the five departments led the change initiative (hereafter referred to as the "grant leaders"). The goal of the larger initiative was to incorporate multiple-week authentic research

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"ASCB®" and "The American Society for Cell Biology®" are registered trademarks of The American Society for Cell Biology. projects into laboratories and/or active-learning activities into lectures to help students think like scientists. Faculty who chose to participate in the project were encouraged and supported to adopt course changes that were consistent with this goal. The grant leaders designed the project to support an emergent change process and, thus, allowed participants to interpret the overall goal quite broadly. For example, some participants chose to incorporate inquiry-based laboratories.

A subset of the grant leaders originally developed the project in response to a funding solicitation that had a limit of one submission per institution. Unfortunately, the institution's internal review board did not choose that proposal for external submission. Shortly after this occurred, a similar solicitation with a broader scope was announced. The subset of grant leaders sent emails to each STEM department requesting collaborators to help expand the scope of the project. The grant leaders sought representation on the leadership team from each department, because they recognized the benefit of improving multiple courses that students took during their undergraduate careers, and because they expected each grant leader to identify specific changes that were appropriate for his or her discipline. In addition, the grant leaders met with department chairs to discuss the proposal. The department chairs pledged their support, but some chairs said they did not expect the grant to be funded.

The grant leaders' proposal included a flexible plan for change. In the proposal, the grant leaders set the overarching goal of the initiative: students doing science by engaging in authentic, inquiry-based, and complex tasks across their courses. Even with this goal, the grant leaders described an initiative wherein decisions on the design and implementation of the changes would be led by members of the departments. They budgeted for this framework by setting aside funds for developing learning communities, hiring postdoctoral scholars to work with faculty, and supporting student research. They also strategized how they could use the budget for new expenses that were not initially anticipated. After the grant funding was awarded, the grant leaders began to identify participants and continued discussions with department chairs.

The project included learning communities, annual retreats, summer workshops, and assistance from postdoctoral scholars. The change initiative hired seven postdoctoral scholars to work with participants in three of the departments (no department had more than one scholar at a time). The project also provided direct financial support for some participants (e.g., for purchasing laboratory equipment or hiring graduate assistants).

The faculty learning communities (FLCs) consisted of six to 15 faculty members (some included postdoctoral scholars and graduate students) and met about twice a month during the academic year. FLCs focused on topics of participant interest (such as laboratory projects, large-lecture techniques, and discipline-specific concerns). Activities included appropriate readings, discussions, and planning activities around participant-led projects. Topics were identified by personal discussions between grant leaders and participants. Each FLC was co-led by faculty facilitators who received a small stipend from the grant for their efforts. Participants volunteered to be part of a FLC and in many cases were recruited by the FLC facilitators and/or the grant leaders.

Most participants in the grant reform efforts first became involved as participants in FLCs and took on course-based proj-

ects as part of an FLC. However, some participants worked independently of FLCs. The goals for course changes within each department were either identified by the members of a FLC (in most cases) or by conversations between grant leaders and individual faculty members.

DEPARTMENTAL CHANGE

Department-level change frames our argument. Recent studies of the process of change in higher education have argued it is critical to understand and focus on department-level change, because departments typically make decisions regarding curriculum and tenure, and department members often discuss their instructional views in both formal and informal venues (Edwards, 1999; Gibbs *et al.*, 2008; Wieman *et al.*, 2010; Quardokus and Henderson, 2015). Departmental change includes individual change, but it recognizes that individual change is not enough. To be successful, a change agent uses tools to think about and design change initiatives that situate individual change within the larger institutional system.

In their review of the literature, Henderson *et al.* (2011) categorize change strategies as either focused on individuals or focused on environments and structures. Department-level change falls in the environment and structure category, which focuses on features of a system that might influence an individual's actions (Henderson *et al.*, 2011). Some examples of these types of systems include promotion guidelines, social structures, or the culture of the department. Hereafter, we refer to these types of changes as "structural change." Henderson *et al.* (2011) identified two contrasting types of structural change. One type, prescribed change, has specific outcomes that the change initiative seeks to realize. The other type, emergent change, develops the desired outcomes throughout the initiative with input from participants.

Prescribed change and emergent change have different assumptions about how and why the process of change occurs. They differ on where new ideas should be developed (by leadership or by ordinary members of the organization); when new ideas should be presented (before the change process begins or throughout the change process); and who is responsible for encouraging, recognizing, and celebrating new ideas across the organization (formal leaders or all members).

Many frameworks describe the change process within the prescribed and emergent categories (Borrego and Henderson, 2014). We identify two specific frameworks that provide tools for change agents to think about and design structural change initiatives. Kotter's eight-stage leadership process represents prescribed change (Kotter, 1996). Complexity leadership theory represents emergent change (Uhl-Bien *et al.*, 2007). As shown in Table 1 and discussed in the following sections, both frameworks recognize four core objectives of change initiatives: create vision, motivate participants, build momentum, and institutionalize change.

THEORY: TWO FRAMEWORKS OF STRUCTURAL CHANGE

Two frameworks of structural change, the eight-stage leadership process (prescribed) and complexity leadership theory (emergent), operationalize the change process. For example, to create vision, the eight-stage process necessitates that powerful leaders define the new ideas of change near the beginning of

TABLE 1.	Overview of	f the four	core objectives	of structural	change
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Core objective of change	Prescribed	Emergent	
Create vision: Change involves new ideas.	Vision is developed by leadership before the start of the change.	Vision emerges through the development of innovations during the change process.	
Motivate participants: People need to behave differently.	Participants are provided with motivation and encouragement to follow the vision.	Participants are provided with motivation and encouragement to create new ideas that lead to the vision.	
Build momentum: New ideas and practices are spread beyond their initial location.	The vision is expanded to include more people and more parts of the organization.		
Institutionalize change: The environment is changed to support sustained use of new ideas and practices.	Organizational structures are changed to support the vision.		

the process and promote them in the organization. However, in complexity leadership theory, middle managers ensure that the formal leaders do not stifle the development of innovative ideas and vision throughout the change process. The following section details the different strategies and timing of events that each framework identifies for approaching the same four change objectives.

Eight-Stage Leadership Process

The eight-stage leadership process is a prescribed change approach developed by Kotter (1996; Table 2). Henderson and colleagues (2011) describe prescribed approaches as "policy change." Researchers who have used this approach describe the change process as the creation of policy and the management of policy compliance (e.g., Elton, 2003; Barth, 2013). Kotter's eightstage framework allows for interpretation of the change process within one cohesive framework that represents creation and management of policy change. Kotter's eight stages were chosen to represent a prescribed structural strategy, because they include the features of prescribed change (e.g., Elton, 2003; Barth, 2013) and are a well-known approach to change in organizations (e.g., Cowan-Sahadath, 2010; Stummer and Zuchi, 2010) and in engineering education change initiatives (e.g., Graham, 2012; Quinn *et al.*, 2012; Borrego and Henderson, 2014).

Kotter's eight stages are sequential. That is, success in earlier stages is necessary for success in later stages. The stages build upon each other to accomplish sustained change across an organization. Some stages can be grouped together according to which aspects of the change process they address. Next, we describe these stages and their coordination in creating structural change.

The first three stages prepare an organization for change through the *development of a vision* (core objective of change: create vision). Establishing a sense of urgency (stage 1) requires a change agent to convince the leadership that "business as usual" will be more detrimental than attempting change. This

TABLE 2. Core objectives and the eight-stage leadership process

Core objective	Stage ^a	Description ^a
Create vision: Change involves new ideas.	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 drive the change initiative.
	3. Developing a vision and strategy	The guiding coalition develops a vision to address the sense of urgency.
Motivate participants: People need to behave differently.	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.
Build momentum: New ideas and practices are spread beyond their initial location.	6. Generating short-term wins	The guiding coalition creates situations that will lead to early successes. They communicate 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.
Institutionalize changes: The environment is changed to support sustained use of new ideas and practices.	8. Anchoring new approaches in the culture	The leadership integrates changes with the culture and systems of the organization.

^aBased upon Kotter, 1996.

can be accomplished by leveraging outside pressure for change (e.g., industry's expectations of graduates' competencies). The establishment for a sense of urgency sets the stage for change agents to assemble a guiding coalition of change (stage 2). Setting the stage for change may be described as motivating leaders to join the coalition. However, we use the terms "setting a stage" to avoid confusion with the objective of "motivating participants," which is described next. To set the stage, change agents should involve powerful, knowledgeable leaders in the coalition to be the drivers of change. Once these two preliminary steps are finished, the first task of the guiding coalition is to create the vision for change and develop a change strategy (stage 3). These three stages work in coordination. The vision should be directly attached to the sense of urgency to create interest within the organization. The theme of these stages is identifying new ideas (create vision) by a powerful guiding coalition at the beginning of change.

The fourth and fifth stages *motivate people to change* their behavior (a core objective of change). Communicating the change vision (stage 4) spreads the change conversation beyond the guiding coalition by referencing the vision in emails, memos, and other communications. The guiding coalition leads by example, by enacting the vision within their practices. In higher education, the guiding coalition may pilot programs within their classrooms. The guiding coalition also empowers broadbased action (stage 5) to involve as many people as possible in change by removing barriers and providing resources to make change possible. The purpose of these stages is motivation. This motivation for change is fostered by the guiding coalition through communication about the vision and support for broadbased action.

Stages 6 and 7 *build the momentum of change* in the organization (the third core objective of change). By generating short-term wins (stage 6), the guiding coalition motivates individuals to stay engaged in change. The coalition plans activities that will have positive results early in the change process (approximately the first 12 months). Positive results are celebrated to

motivate further change. This leads to consolidating gains and producing more change (stage 7). This stage avoids declaring victory prematurely. The guiding coalition continues to promote the vision by moving change to new, untouched areas of the organization. The combined purpose of these stages is building momentum across the organization. The new ideas spread beyond the initial participants because of the connection of celebrated successes to change initiative activities.

The final stage focuses on institutionalization (the fourth core objective of change). Anchoring new approaches in culture (stage 8) leverages the structural features of the organization to maintain changes. Change agents anchor the change in the norms of the organization. This stage is the culmination of all the previous stages. For example, in an academic department, it may become the norm after a change initiative to expect new hires to have knowledge of evidence-based instructional practices. The purpose of this stage is institutionalizing change in the structure of the organization.

The eight stages are a structural, prescribed approach to change. The process begins by developing a vision and then motivating others to follow this vision (prescribed); the process impacts individuals of the organization and changes the structures of the organization (structural). The eight stages can be portioned into the four core objectives by combining stages that act in coordination to accomplish a goal (Table 2). These core objectives include specific actions that change agents take to accomplish change (create vision, motivate participants, build momentum, and institutionalize changes). In the *Discussion* section, we use these core objectives to identify change agent actions in the case studies that were beneficial for change and missed opportunities when change agents could have used the eight stages to promote change.

Complexity Leadership Theory

Complexity leadership theory is an emergent approach to change developed by Uhl-Bien and colleagues (2007; Table 3). In complexity leadership, the change process is complex and

Core objective	Cycle events ^a	Description ^a
Motivate participants: People need to behave differently.	 Disrupt existing patterns to encourage new interactions between individuals. Develop structures that create interdependency to encourage teamwork. 	Change agents (who have the support of formal leaders or are formal leaders themselves) develop structures to encourage innovators by promoting interaction, interdependency, and tension. This is often done by disrupting existing patterns and developing simple rules to guide interactions.
Create vision: Change involves new ideas.	Encourage dissenting opinions.Avoid stifling regulations.Articulate the vision.	Change agents (as formal leaders or through encouragements of formal leaders) provide an environment where innovators can be successful and encourage the communication of new ideas.
Build momentum: New ideas and practices are spread beyond their initial location.	 Interpret emerging events to identify new knowledge. Communicate emerging knowledge and associated new practices to formal leaders. 	As new innovations arise, change agents promote them if they advance the shared vision of the organization and fit the simple rule.
Institutionalize changes: The environment is changed to support sustained use of new ideas and practices.	• Promote institution-level learning by modifying structures to align with new knowledge and practices.	Change agents who are also formal leaders develop structures that sustain the change from the earlier cycles.

TABLE 3. Core objectives and complexity leadership theory

^aBased upon Uhl-Bien et al., 2007.

emergent; leadership activities of individuals throughout an organization lead to change, as opposed to a change process that is managed by leaders. Complexity leadership identifies the roles of administrative, adaptive, and enabling leadership in the change process. Administrative leaders are formal leaders who create the regulations and rules of the organization. Adaptive leaders are innovators within the organization who develop ideas through creative, generative interactions with at least one other individual. These individuals can have any role in the organization; they may be formal leaders, but they could also be typical workers. Enabling leaders are the change agents. Change agents 1) encourage innovators to develop new ideas, 2) promote communication between the innovators and the formal leaders, and 3) work to institutionalize productive innovations. Again, change agents may be in any position within the formal hierarchy of the organization. One person may at times be a formal leader, innovator, and/or change agent.

Complexity leadership is a cycle that forms an ongoing, iterative process (Figure 1). Because this cycle is ongoing, it does not necessarily start with a plan for transformative change. Instead, small positive changes are magnified. They build upon each other in nonlinear (complex) ways that lead to structural change in the organization. Next, we describe the parts of this cycle. Change is never complete from the perspective of complexity leadership; after institutionalization, a new cycle begins. In addition, several cycles of change can happen simultaneously as various small positive changes are identified and magnified to lead to structural change.

The first part of the cycle is *motivating innovation* by encouraging interaction, interdependency, and tension throughout the organization (change objective: motivate participants). In contrast to the eight stages, motivation precedes vision development. A change agent promotes innovators by encouraging *interaction, interdependency*, and *tension* throughout the organization. This could take the form of *disrupting existing patterns* by assigning teamwork on tasks for which individual success is dependent on group outcomes. For example, two instructors may be assigned to coteach a course and struggle to write the final exam because each person values a different approach to assessment. The new coteaching assignment is a *disruption of patterns* that leads to *interactions* on an *interdependent* activity. The different approaches to exam writing create *tension* between the instructors. Finding a solution to this tension (that is acceptable to both instructors) may require the instructors to develop an innovative approach to exam writing. These types of arrangements *motivate* new behaviors.

Simple rules are guidelines that steer the change process during each part of the change cycle and across multiple cycles. A simple rule is the mission of change; it defines the type of outcome an action should create, although the details of the action are not specified (Plowman et al., 2007; Uhl-Bien et al., 2007). For example, in the first part of the cycle, motivation can be guided by a simple rule. In the coteaching example, a simple rule may be that graduates of a program should develop written communication skills. This simple rule would not prescribe a specific solution (such as a style of exam), but it can determine whether specific solutions (such as exam questions with openended responses) fit within the simple rule. In the second part of the change cycle, change agents encourage the communication of new ideas to articulate a shared vision (core objective of change: create vision). This process is facilitated through encouraging dissenting opinions, avoiding stifling conditions, and detailing the vision related to a new idea. Encouraging dissenting opinions and avoiding stifling conditions allow for innovators to share new ideas with members of the organization. After developing an innovative open-ended exam, the co-teachers may want to share the innovation in a faculty meeting. Perhaps the chair of the graduate committee would prefer multiple-choice exams, because they are easier for teaching assistants to grade. At the faculty meeting, the department chair could act as a change agent. First, he or she would determine that the innovation fits with the simple rule of the department. Next, the department chair could encourage interactions between the graduate committee chair and the innovative co-instructors to refine their innovation. Finally, he or she would want to avoid stifling conditions by not allowing a mandate to be instated that requires a specific type of exam. These interactions may result in the creation of a rubric that can be used for



FIGURE 1. The four core objectives of change in the linear progression of the eight-stage leadership process and the cyclical progression of complexity leadership theory.

grading the open-ended exams. This new development articulates the vision associated with the innovation: students increase their written communication skills through open-ended exams that are assessed with well-designed rubrics. In this cycle, new ideas lead to an articulation of the vision.

A vision and a simple rule can be difficult to distinguish. We use "simple rule" to describe an overarching guideline within which multiple solutions (visions) can successfully exist. A simple rule sets constraints, but does not provide a plan of action. A vision is a specific solution that can be used to guide the development of a plan of action.

The third part of the cycle includes promoting changes by *communicating the shared vision across the organization* (core objective of change: build momentum). A change agent provides language to frame and discuss new ideas (including the simple rule) and promotes these ideas to formal leaders. This role is likely to be an important activity of middle managers. A middle manager has interactions throughout the organization that can help identify new ideas and connections with formal leaders to promote these ideas. In higher education organizations, these middle managers may be department chairs who have connections with deans and provosts but are also connected to instructors. For the openended exam example, the co-teachers might communicate their vision across the organization by helping others develop similar exams. This partnership would allow the co-teachers to define what it means to give an open-ended exam and how rubrics are created to assess the results. These new definitions could be used to frame discussions with college deans and instructors across the university.

The fourth part of the cycle is institutionalizing changes (core objective of change: institutionalize changes). Formal leaders create structures that support and sustain the new ideas. This step represents the end of a single cycle, but change agents should expect change to be ongoing, even after new structures are in place. For this part of the cycle, the department chair could decide that coteaching assignments would include developing exams and associated rubrics. The innovation continues within the institution and allows for ongoing change of assessment practices.

Complexity leadership represents a structural, emergent approach to change. It targets all levels of the organization to promote the development of new ideas. Change agents (enabling leaders) support the emergence of new ideas developed by innovators (adaptive leadership) by creating interactions with interdependency and tension and communicating new ideas to formal leaders (administrative leaders) to institutionalize change.

Complexity leadership was chosen to represent emergent, structural change for two reasons. First, it represents the emergent change approach that higher education researchers expect to be important for change. Emergent change includes promoting interactions between participants and developing a flexible vision (e.g., Eckel and Kezar, 2003). Second, complexity leadership has been informative in organizations other than higher education (e.g., Plowman *et al.*, 2007). Our analysis investigates how complexity leadership can contribute to understanding of change in academic departments.

Core Objectives of Change: Strategies from Two Frameworks

Both frameworks identify the same four core objectives that are needed to promote change: create vision, motivate participants, build momentum, and institutionalize change (Tables 2 and 3 and Figure 1). We call these themes the "core objectives of change," because they emerge from the contrasting approaches to departmental, structural change. Recall the two frameworks were not only chosen because of their use by other researchers to understand change, but also because each framework contained the main features that change researchers have used to describe emergent and prescribed approaches to change (e.g., Eckel and Kezar, 2003; Elton, 2003; Barth, 2013). Structural change occurs when these shared core objectives are achieved. However, there are differences within the core objectives. Each framework seeks to achieve the core objectives in a different order and with different strategies. A challenge facing change agents is deciding which of these strategies to use and how to sequence strategies and specific activities within strategies to achieve the core objectives.

Change agents consider contextual questions when determining what strategies and activities are appropriate for promoting change: Who is willing to play an important role as an agent of change (e.g., department chairs, deans)? What type of events will be well-received (e.g., teaching co-assignments, group discussions)? When can events occur (e.g., before change, during the process of change)? The two frameworks provide change agents with core objectives, strategies within the core objectives, and flexibility to design initiative activities that are appropriate within their context. In the analysis, we use these four core objectives to guide the discussion of the case studies of five departments.

METHODS

The case studies are five departments at a research, doctorategranting university involved in a grant-funded change initiative. Participants were encouraged to incorporate multiple-week authentic research projects into laboratories and/or activelearning activities into lectures to help students think like scientists. Change initiative supports included learning communities, annual retreats, summer workshops, and assistance from postdoctoral scholars. Data collection occurred during the first three-and-a-half years.

Five department-based case studies provided an in-depth, qualitative understanding of the complex nature of change. This study was approved by appropriate human subject review boards. The study's purpose is to provide guidance on how higher education change agents who are planning and leading change within academic departments might match strategies and activities to the local departmental context to achieve the core objectives of change. To address this purpose, case studies were used to provide in-depth description of the five departments where change was attempted and to interpret the events of change in each department with the two frameworks.

In holistic, multiple-case studies, multiple sources of data describe a single case (Yin, 2009). The departments are considered separate case studies, because they are relatively independent departments within a larger change initiative. As discussed earlier, the grant leaders set out to design an initiative in which department members would design and implement changes. Specifically, the grant leaders provided postdoctoral scholars and FLCs as support for emergent change. Department members viewed these resources as knowledge sources, not as actors who would prescribe or lead change. Because of this customization of change by department, this study investigates how and why grant activities created department-level change.

The data collected (interviews, surveys, change initiative artifacts, and departmental artifacts) identified the departmental structure, change initiative activities, and social connections. Research participants included department members (grant leaders, participants and nonparticipants in the change initiative, tenure and non-tenure track instructors, support staff, and postdoctoral scholars or graduate students who were involved in change) and members of the teaching and learning center. Department sizes ranged from 25 to 60 department members (Table 4). For the purposes of this study, department members

TABLE 4.	Overview o	of key change	features within	each department
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Department	Overview		Description
A	Members Participants Lab courses changed Lecture courses changed	60 9 6 1	 The PI identified interested instructors and allotted change initiative funds to support course changes. Nonparticipating department members (including the chair) were often unaware of changes. Two participants with expertise in a disciplinary specialization led a laboratory change. The members of this disciplinary specialization met weekly and often discussed instructional topics.
В	Members Participants Lab courses changed Lecture courses changed	40 15 6 —	 Participants worked individually to change five courses from step-by-step to inquiry-based laboratories and one course to include an authentic research experience. The chair promoted inquiry-based projects, because authentic research would be too hard with their large student numbers. Department members wished to have undergraduates work in their research laboratories and believed that inquiry-based laboratories would prepare students for laboratory research.
С	Members Participants Lab courses changed Lecture courses changed	25 5 1 1	 The participants discussed their course changes with one another and participated in change initiative FLCs. The other department members did not value the vision of authentic research experiences. The participants believed changed courses would revert back to traditional style if different department members were assigned to teach them.
D	Members Participants Lab courses changed Lecture courses changed	45 18 1 1	 Nine participants attended a department-based FLC to add active-learning modules to an introductory lecture for majors with multiple sections. This was the main focus of change in this department. The department chair assigned research-intensive faculty to coteach the course to create a community of supportive department members. A co-PI of the project became department chair. She spoke about and promoted research-based instructional practices in departmental meetings and personal conversations.
Ε	Members Participants Lab courses changed Lecture courses changed	45 11 2	 One course changed briefly but returned to traditional style. A second course change would have likely occurred with or without the support of the change initiative. The chair spoke positively about the change initiative but had little involvement. An FLC focused on the introductory lecture course discussed learning objectives but eventually stopped meeting. FLC participants had two different perspectives of course goals: content coverage vs. promoting scientific thinking. The FLC facilitator saw himself as resource of educational information.

were faculty who were likely to influence teaching in the department. This included tenure-track and fixed-term faculty. Graduate students and postdoctoral scholars were included as department members if they were participating in change initiative activities. Understandably, this definition of departmental membership means department size varied slightly over the course of the project. The results specifically discuss department member changes that impacted the study of the change. Table 4 reports a snapshot of the number of department members at the end of the project and change initiative participants over the data-collection period.

This analysis and research stemmed from an extension of the external evaluation of the grant. The external evaluation provided both formative and summative feedback to grant leaders on the process of grant activities. Several times a year, the principal investigator (PI) and the authors (external evaluators not directly involved in change activities) discussed the progress of the project based on data collection and potential avenues for improvement. Formative evaluation was used to improve the project. These case studies (the research analysis with frameworks) occurred after the completion of the data collection. The research analysis did not seek to understand why the grant leaders made the decisions they did (which were influenced by formative evaluation) but instead focused on how and why these actions led to or did not lead to change in the departments.

Interviews, change initiative artifacts, and social network surveys were the primary sources of data. These sources were privileged, because they provide detailed information about the process of change. Fifty-four interviews were conducted over the three-and-a-half years. Each data-collection cycle focused on a different set of interviewees. In year 1, the interviewees were FLC facilitators (6) and a cross-section of stakeholders, including department members and center for teaching and learning staff (14). In year 2, interviewees were department D and E members (9) and members of an interdepartmental FLC (5). In year 3, interviewees were a cross-section of department members involved in change (20). Each data-collection cycle included interviews with department members who were grant leaders, facilitators of the FLCs, and grant postdoctoral scholars. Change initiative artifacts (total of 9 artifacts) included year-end reports to the funding agency, meeting minutes of the grant leaders, and presentations made by participants at the annual retreat. Social network surveys were also collected during year 2 and year 3. The response rate for each department ranged from 37 to 65% (for more details on instruments, see Quardokus, 2014).

The four-stage analysis focused on understanding the process of change of each department. We illustrate how these stages led to results with an example from the analyses. In the first stage, themes were developed from interviews and artifacts using emergent qualitative analysis techniques (Corbin and Strauss, 2008). For example, in one department, a theme of isolation emerged from three individuals. These interviewees claimed that they were the only members of their department who were interested in teaching-related issues.

The second stage articulated or triangulated themes with data from the surveys and arranged themes into a departmentallevel change narrative. Departmental narratives included key actors, events, and context (participant-provided description of the purpose, success, and interpretation of change events). For example, to investigate the theme of isolation, the social network of the department was investigated. From the network, it was clear that the three individuals were not involved in conversations about teaching with other people in the department. However, it did not support the claim by participants that others in the department did not have any interest in teachingrelated issues. This triangulated and articulated the theme of isolation.

In the third stage, the narratives were compared to identify similarities and differences. These comparisons were used to identify change initiative activities that may have been identified in one department but overlooked in another. For example, after a socially isolated group was identified in one department, similar isolated groups were searched for in other departments. After this stage, departmental narratives were read by at least one member of the change initiative as a second check for overlooked or misrepresented narrative elements.

In the last stage, each narrative was interpreted through the lens of two theoretical frameworks (the eight stages and complexity leadership). The theoretical frameworks provided insight into the importance of the features of the narrative. The elements of the departmental narrative were identified given each framework's strategies within the core objectives of change, including who was involved, what change activities were created, and when in the process of change the activities occurred. In the departmental narratives, each core objective was identified as either attempted or a missed opportunity to promote change. In cases in which the core objective was attempted, the events and outcomes of the events were described. In general, the overall success of changes to the department were measured by changes to courses taught by department members that would impact student learning.

In the example of the isolated participants, the isolation occurred throughout the change process. For both frameworks, one example of a core objective impacted by isolation is creating a vision. For the eight stages, isolation of innovators indicates that these innovators were not members of a guiding coalition because they were not the formal leaders. For complexity leadership theory, isolation of innovators means that the vision cannot be articulated, because the innovators do not have the opportunity to share in and refine the vision of the innovation. The result of this isolation (and the other activities in the department) was limited success in changing courses unless they were taught by the three individuals who felt isolated.

RESULTS: DEPARTMENTAL NARRATIVES

This section contains brief descriptions of departmental narratives (labeled as Departments A–E; Table 4). The departmental narratives include the departmental context and main events of the change process. In the following *Discussion* section, both frameworks were used to interpret the change process (subdivided by the core objectives of change).

Department A

Department A had 60 members; nine members participated in the change initiative, including the PI of the grant. The PI identified interested instructors and allotted change initiative funds to support course changes. Changes were made in seven courses. The PI allotted project funds to send an individual to a workshop on rewriting laboratories and to buy equipment to conduct experiments for an authentic research experience. Many instructors worked individually to create course changes, and nonparticipating department members (including the chair) were often unaware of changes. A course within a disciplinary specialization that was changed to include an authentic research experience was an exception to this pattern. The instructor who was planning to teach the course in the following semester contributed to course changes. The department members with expertise in this specialization met weekly and often included discussion of the course in these meetings. One department member described these teaching discussions as focusing on challenges facing the students in their subdiscipline. He says, "[We discuss] the problems. The students are not many, so we [discuss their challenges] individually." This department member describes a detailed discussion of courses in which the members of the disciplinary specialization even discuss specific students.

Department B

Department B had 40 members. Fifteen members participated in the change initiative, including two postdoctoral scholars and the department chair. Participants modified six laboratory courses from step-by-step to inquiry-based laboratories. Several faculty members joined a change initiative FLC focused on changing 300-level courses and collaborated to modify a 300level laboratory. One faculty member, who did not discuss his changes with colleagues, developed a laboratory with a 5-week authentic research experience. Department B's chair and postdoctoral scholars' mentors argued that inquiry-based projects rather than research experiences were more appropriate for their courses. For example, the chair argued authentic research would require constant revision, whereas inquiry-based projects would need fewer modifications from year to year. While comparing inquiry-based laboratories with authentic research experiences, the department chair argued, "Whereas, if you take the same project or the same basic project and you turn it into an inquiry-based [laboratory] that is only quasi research, then you can keep that experiment around for longer." He suggested that inquiry-based laboratories would prepare students for laboratory research. The chair used these reasons to encourage instructors to design inquiry-based laboratories.

Department C

Department C had 25 members; five department members and one graduate student (later hired as a lecturer) participated in change. Three of the participants modified two courses to include multiweek authentic research experiences. The participating department members believed they were the only members concerned with instructional issues. One department member described how change would not happen if she were to abandon the project. She said, "If I'm gone [change is] not going to happen simply because there isn't anybody else [except the other two participants] in my department that is really invested." These individuals discussed teaching with one another, but not with other department members. The PI agreed that other department members were not interested in changing their practice to incorporate authentic research experiences. However, he believed they really cared about helping students effectively apply mathematics skills in their science disciplines. The participants found support for their work from one another and participation in change initiative FLCs. In addition, the change initiative participants believed the courses they changed would revert to traditional courses if a different department member were assigned to teach those courses.

Department D

Department D had 45 members. Eighteen members (including three postdoctoral scholars) participated in the change initiative. Four department members changed an upper-division laboratory course to include an authentic research experience. Two department members attended a workshop with funds from the project. Nine department members changed a single course to include active learning-an introductory lecture for majors with multiple sections. Before the change initiative, teaching-intensive department members taught this course. The department chair assigned research-intensive faculty to coteach the course. These department members recognized FLC participation as a resource for developing this course. One member of the FLC described it as, "The payoff is not a small stipend that [the grant] gives [the participants], or anything they put on their CV. It's the possibility that by working together, they can all be more efficient and more effective and get to feel better about what they're accomplishing. That's what keeps them going." The chair intended the coteaching assignments to lighten the burden of teaching the course and to create a community of department members who could appreciate the difficulty inherent in teaching the introductory course. These participants introduced active-learning modules into their lectures.

One of the grant leaders became the chair during the change initiative. She continued the previous chair's routine of rotating instructors in and out of the introductory lecture. Each time she assigned a new instructor to any course, she encouraged the instructor to use research-based instructional practices. She also spoke about and promoted research-based instructional practices in departmental meetings. The coteaching instructors and postdoctoral scholars participated in the change initiative to develop materials for the introductory course. The chair promoted their activities by discussing instructional issues in departmental meetings. However, a member of the department who had not yet taught the introductory course said she felt the resources were only available for instructors of the introductory course.

Department E

Department E had 45 members. Eleven members participated in change initiative activities, including three postdoctoral scholars. A faculty member, a laboratory coordinator, and two postdoctoral scholars developed a new curriculum for an introductory laboratory. This change would have likely occurred without the support of the change initiative, but the initiative provided the postdoctoral scholars to facilitate changes. The chair spoke positively about the change initiative but had little involvement. One other course changed briefly but returned to the traditional style when a new department member was assigned to teach it.

Department E hosted a learning community focused on the introductory lecture course. The FLC facilitator saw himself as a resource of educational information, but not as needing to change his instructional approach. FLC participants had two different perspectives of course goals: content coverage and scientific thinking. The learning community agreed on some shared learning objectives for the course but never made significant changes. This FLC decreased in size after the initial year and eventually stopped meeting. The facilitator noted, "It may be that [the FLC participants] felt like they got all that they could [get] out of it [the FLC]. And, they don't see any point in continuing to put the effort in [attending FLC meetings]. Or, it may literally be they just simply don't have the time, but people tend to make time for things that they prioritize." Despite this discouragement, the facilitator did not give up his efforts to continue to foster communication. A postdoctoral scholar started a weekly newsletter for lecture and laboratory instructors to provide information on the state of each section. The change initiative participants hoped to restart the FLC in the following years.

DISCUSSION: FOUR CORE OBJECTIVES OF CHANGE

Each department had a unique change narrative. Sometimes the same change activity was more successful in one department and less successful in a different department. For example, in both Department D and Department E, an FLC was intended to lead to change in an introductory lecture. However, while the FLC participants in Department D changed the delivery of the course, the course in Department E remained unchanged. This suggests that the participants in Department E may not have achieved at least one of the core objectives of change. The frameworks of the eight stages and complexity leadership models provide explanations for why seemingly similar approaches did not result in similar outcomes and guidance for choosing strategies and designing activities to promote change.

In this section, we discuss the change narratives from the perspectives of the two frameworks. We use both frameworks to demonstrate how thinking about change in more than one way can be useful for change agents when considering change context and strategies. The discussion is organized by the core objectives of change. We provide descriptions of each department within the core objectives. These descriptions always appear in the same order, starting with Department A and concluding with Department E. The department participants' attempts to achieve the core objectives are characterized by what events took place, who was involved, and when during the change process it occurred. The departments with participants who made more successful attempts to achieve the core objective are used to suggest productive activities for creating departmental change. Here, success is determined by achieving

the core objective (creating a vision, motivating participants, building momentum, or institutionalizing change), which represents one step toward reaching the goal of improving student outcomes through changed courses.

Create Vision

In the eight-stages process, the *guiding coalition develops a vision* that is connected to the *sense of urgency* for change. In complexity leadership, the change agent *creates productive environments (avoids stifling regulations and encourage dissenting opinions)* that allow innovators to *develop ideas that provide an articulation of the vision* that complements the simple rule. Course changes in the department that were connected by shared goals indicated a vision had been created. Participants in Departments B and D developed visions for change. Participants in Departments A, C, and E struggled to identify a vision.

In Department A, a shared vision for change was not identified. The lack of vision was made evident by the number of faculty who were working individually on various changes and rarely moving toward a similar goal. It is possible that the PI had identified a vision for the department, but the other participants in the department were not aware of a shared goal.

The vision in Department B was created by the chair and department participants before change occurred and focused on developing inquiry-based laboratories for their students. The number of individuals who took on this shared goal provides evidence of the creation of a vision. From an eight-stages perspective, the chair and the participants identified a sense of urgency (the need to prepare undergraduate researchers) for promoting change and included formal leaders in the guiding coalition. From a complexity leadership perspective, the FLC participants who create inquiry-based laboratories in the 300level course were provided with an environment that could help them articulate the vision. However, according to complexity leadership, this vision should have not been identified before these interactions. For example, an alternative approach could have been to use "prepare undergraduate researchers" to guide FLC interactions as a simple rule without prescribing inquiry-based laboratories as the appropriate vision for change.

The participants in Department C struggled to identify a vision. Here, the vision was limited to three individuals who worked toward creating course-based research projects and participated in external FLCs. These participants said that other faculty members in their department were uninterested in making changes; it is not clear how they came to this conclusion or how they might have attempted to share their vision with others.

The vision in Department D focused on implementing active-learning modules in the introductory lecture course. This vision was developed by FLC participants during the process of change. From the eight-stages perspective, the assignment of the grant leader to the position of chair was important for success. Although the vision was already developed by the time the chair could have influenced it, she used her position to encourage faculty members to become part of the change effort. From the complexity leadership perspective, the vision was developed from the environment of the FLC, which allowed for communication and dissenting opinions. This development was guided by the simple rule identified by the grant leaders: to promote scientific thinking. Furthermore, postdoctoral scholars' participation in the FLC represents a productive environment by relieving some of the burden of developing the active-learning course materials.

In Department E, a limited vision was led by a faculty member who had identified the changes he hoped to make before change. He shared this vision with his postdoctoral scholars but not with many other people in the department. The FLC made little progress toward identifying a goal for its community, before or after change.

Missed Opportunities. From the perspective of the eight stages, the department members (A, C, and E) who did not develop a vision missed opportunities to create a sense of urgency and to involve powerful leaders in a guiding coalition. From the perspective of complexity leadership, the main missed opportunity was environments for communication to occur (Departments A and C) or a lack of guidance by the simple rule to move toward vision creation through interactions (Department E).

Potential Activities. The departments that achieved this core objective can be used as examples of how departments can develop vision. From the perspective of the eight stages, vision includes identifying a sense of urgency and creating a guiding coalition. In departments, this could mean identifying an internal need, such as preparation of undergraduates for working in research faculty laboratories. Furthermore, involving the department chair in a guiding coalition can compel others to follow the vision. If a change agent determines that the department chair is not willing to join a guiding coalition, the complexity leadership approach to vision development may be more appropriate for this context. The complexity leadership strategy requires the department chair not to stifle change and to be open to change throughout the process. Like the change that occurred in Department D, a strategy to develop a vision could include faculty participation in a departmental FLC. The FLCs activities would need to be guided by using the change initiative's goal as a simple rule. To avoid a lack of activity or isolation of innovators, this process should use the simple rule to encompass the interests of many faculty members.

Motivate Participants

In the eight stages, participants are motivated to change when the guiding coalition effectively communicates the vision and empowers broad-based action by providing rewards for changing and resources for change. Motivation is the first part of the complexity leadership change cycle; participants' motivation is supported via innovation through interactions, interdependency, teamwork, and disruption of patterns and guided by the simple rule. The departmental narratives were used to measure participation by identifying how many participants were involved in making changes to courses and whether these changes occurred early in the grant's timeline. The core objective of motivating participants was achieved in Departments A, B, and D. In contrast, in Department C, only a few isolated individuals were motivated to make changes and only two courses were changed. In Department E, individuals attended FLC meetings, but many of these members were not motivated to make changes.

In Department A, there were nine participants and seven changed courses. Six of these courses were changed in the first two years of the grant. Because a vision was not identified in Department A, these participants were motivated to be involved in change before vision development. The participants were invited to participate in the change initiative through conversations with the PI of the grant, and they were provided with resources such as laboratory equipment and funding to attend an education workshop. Two faculty members collaborated on changes made to a laboratory and lecture course and shared these efforts within their disciplinary specialization in the department. From the perspective of the eight stages, the PI of the grant acted as a guiding coalition by providing resources for making changes. However, the successes were not communicated to others in the department, and participation did not increase over time. From the perspective of complexity leadership theory, the two faculty members who collaborated on one course created an interdependent relationship and used teamwork to make changes.

In Department B, there were 15 participants and six courses were changed. Five of these courses were changed toward the beginning of the grant. The department chair encouraged individual laboratory coordinators and faculty to make changes after inquiry-based laboratories were identified as the main activity needed to achieve the vision. The chair communicated this desire through individual conversations. Some faculty members participated in the 300-level course FLC to make changes to a lecture and laboratory. From the perspective of the eight stages, the chair acted as the guiding coalition by motivating participants to follow his vision by implementing inquirybased laboratories. The 300-level course FLC provided resources for learning about and implementing changes. From the perspective of complexity leadership, the FLC was an opportunity for interactions that led to new innovations. There were missed opportunities to create interdependent efforts between laboratory coordinators who were implementing changes at the same time

In Department C, there were five participants and only two courses were changed. All changes started near the beginning of the grant. These smaller participation numbers may be partially due to the smaller size of the department. In this department, the isolated individuals were encouraged to make changes through individual conversations with the grant leaders. These conversations occurred at the beginning of the change initiative. The participants were supported by a grantbased FLC but did not collaborate with other members of their department.

In Department D, there were 18 participants and two courses changed. The planning for these course changes started at the beginning of the grant. Given the number of courses changed, it may seem like the core objective of participant motivation did not occur. However, many participants contributed to the changes made in the lecture course, for which many sections were cotaught. The participants were invited to make changes before the vision was identified. The course changes were supported by a department-based FLC and were acknowledged at faculty meetings. From the perspective of the eight stages, the chair acted as the guiding coalition by using her authority to encourage changes through individual conversations. Resources were provided in the form of knowledge gained at the FLC meetings, and rewards included acknowledgment at faculty meetings. From the perspective of complexity leadership, coteaching assignments in the introductory lectured acted as a disruption of patterns (before vision development) and led to innovation through FLC interactions between interdependent members. These interactions were guided by the simple rule set by the change initiative.

In Department E, there were 11 participants and two courses were changed. Many of the participants attended the FLC but did not make any changes to their courses. In the beginning of the change initiative, participants were asked to join the FLC by the cofacilitator of the FLC and/or the grant leaders.

Missed Opportunities. The participants in the less successful departments (C and E) did not implement activities to achieve the core objective of motivating participants. According to the eight stages, both departments lacked a guiding coalition that could have empowered broad-based action. In both departments, the department chair was not a participant in the change initiative. Unlike Department A, these departments did not have an informal leader who was willing to use individual interactions to promote change. The cofacilitator of Department E's FLC was an information resource not a member of a guiding coalition. This was a missed opportunity for the facilitator to act as a communicator of the vision and to empower broad-based action in the FLC. From the perspective of complexity leadership, Department C lacked interactions between department members. The grant-based FLC allowed participants to interact among themselves, but not with others in the department. There was also no interdependency and no simple rule. In Department E, an FLC provided a venue for interactions between many department members, but a disruption of patterns, interdependency, and connection to the simple rule were missing.

Potential Activities. From the successful narratives of motivating participation (A, B, and D), a change agent can identify specific activities that have worked in building momentum within the departmental context. From the perspective of the eight stages, a formal leader can promote the vision through personal interactions and provide resources such as funding for laboratory equipment and postdoctoral scholars and for developing FLCs to help department members learn about new approaches. In addition, a chair can acknowledge participant efforts in visible ways, such as during faculty meetings. From the perspective of complexity leadership, a simple rule, such as students acting as scientists, should be used to guide the innovations of participants. Interactions in FLCs can lead to innovation when participants are interdependent and members of the same department.

Build Momentum

Building momentum through communication extends change from initial participants and contexts to more individuals and different areas of the organization. The eight-stages guiding coalition consolidates gains and produces more change by generating and celebrating short-term wins. In complexity leadership, change agents build momentum by interpreting emerging events to identify new knowledge and communicating emerging knowledge to spread these changes to new areas. Departmental evidence of momentum building included: refining changes in courses over time, changing new courses, and/or adding new participants. The core objective of building momentum was achieved within Department A by members of a disciplinary specialization and in Departments B and D. In Departments C and E, changes were not expanded beyond the original contexts and courses.

In a disciplinary specialization of Department A, the changes to a course were codeveloped by two faculty members. These faculty members built momentum by sharing their progress with other faculty members in the specialization through discussions at weekly, formal meetings. These meetings happened throughout the change process. This is a tenuous example of building momentum, because the group's discussions only led to increased group awareness of the course change. The discussions did not lead to changes in additional courses. It may be that the grant leaders should have approached Department A as two smaller units within a single department. If they had chosen this perspective, then the members of the disciplinary specialization might have built momentum by building awareness through discussions. However, the grant leaders built their initiative around departmental boundaries. According to the eight stages, an important role of the discussions is to celebrate the short-term wins of the initial changes. A missed opportunity was leveraging this celebration of wins into creating even more change. From the perspective of complexity leadership, these discussions provided an opportunity for change participants to create a shared language for understanding their innovations and a chance to communicate innovations with others. As with the eight stages, an opportunity was missed to use this communication to create even more change.

In Department B, new participants and course changes continued to occur as the chair recruited more department members to develop inquiry-based laboratories. His recruitment efforts occurred throughout the process of change. According to the eight stages, the chair's recruitment is the continued encouragement by the guiding coalition to make changes. The data sources did not indicate whether the chair celebrated shortterm wins in his attempts to recruit new participants. From the perspective of complexity leadership, the role of the chair was to identify what was happening in the changed courses and to develop the language for sharing this knowledge with others. However, because the interviewees did not report on details of the recruiting discussions, it is not possible to determine whether this technique was used.

In Department C, the change initiative did not spread to new participants or impact new areas in the department. The isolated innovators continued to work individually.

In Department D, participants continued to improve the introductory lecture, and near the end of the grant, participants were beginning to change laboratories. The department chair (grant leader) encouraged faculty members to join the FLC when they taught the changed introductory lecture course and continued to encourage each faculty member to use researchbased instructional strategies. She did this both in faculty meetings and individual conversations. From the perspective of the eight stages, the department chair generated short-term wins by providing resources; specifically, she provided support through the FLC. She celebrated short-term wins at faculty meetings by recognizing participants and through personal communications. Furthermore, she produced more change by continuing to assign new faculty members to coteaching assignments. From the perspective of complexity leadership, the chair recognized useful innovations that were developed in the FLC, and she communicated these ideas to others when they were assigned to new courses. This led to even more change.

In Department E, the participants did not build momentum. Postdoctoral scholars worked with their mentors to make new changes, but the participants indicated that this change would have happened even without the added support.

Missed Opportunities. In the departments that did not build momentum (C and E), the department chairs were not involved in change. In Department E, the chair said he was supportive of change, but took a hands-off approach to impacting change. In Department C, the chair was not involved with change at all. While the chairs were not involved, an alternative could have been for an informal leader to identify and celebrate wins. The lack of a guiding coalition meant no structure existed to use the eight stages to generate and celebrate short-term wins. From the perspective of complexity leadership, the momentum in the departments could have been built by informal leaders through identifying and communicating emerging knowledge. Department C participants had discussions among the faculty members involved directly with change. However, these individuals did not have a mechanism for interacting with the other members of the department. Such interactions could initially have been developed by these members through personal communications or asking for permission to share their work at department-wide events.

Potential Activities. The more successful departments (B and D) both had a department chair who was actively involved in building momentum. Department A provides an example of how interactions might build momentum when the formal leader is not involved. According to the eight stages, the department chairs in B and D used faculty meetings to celebrate wins. In Department A, faculty members at the weekly meetings also built momentum by celebrating wins. According to complexity leadership, the meetings, whether led by the chair or not, were opportunities for the participants to provide language for identifying and discussing emerging innovations.

Institutionalize Changes

Institutionalization involves altering structures to support change in the future. In academic departments, structural alterations could mean that the course structure is formally adjusted to include change such as inquiry-based laboratories. It also could mean a change in departmental culture toward valuing the type of work that was promoted by the change initiative. The eight stages institutionalize change in the final stage. The *guiding coalition anchors new approaches in the culture*. In complexity leadership, institutionalizing change is an ongoing process. The *change agents who also are formal leaders modify structures to align with practice*.

The five departments made few changes to formal structures. In addition, the data collected for this study did not indicate whether tacit features, such as culture, had changed. Instead, potential institutionalization was indicated by an expectation from participants that the changes would continue in the future or by the transition of a changed course from one instructor to a newly assigned instructor. In Department A, two courses were transferred from one instructor to a second instructor. In addition, other participants intended to continue to teach their courses, but it was uncertain whether these changes would continue if their teaching assignments were to change.

Participants in Department B were partially successful in institutionalizing change. Both the chair and the laboratory coordinators expected that laboratory courses offered by the department would continue to be inquiry-based. According to both the eight stages and complexity leadership, this institutionalization occurred because the chair's formal support led to change.

In Department C, the participants who made changes planned to continue these changes in the future. But they believed that these changes would not be maintained if the courses were assigned to new instructors.

Department D's participants expected changes to continue because of the chair's activities. As a formal leader and a change agent, the department chair assigned co-teachers to the introductory laboratories and used faculty meetings to support a vision of research-based instructional practices. According to the eight stages and complexity leadership, the chair's structural practice of assigning co-teachers and expectations for use of research-based instructional practices represent the aligning of systems with the new changes developed by the participants in the department.

In Department E, there was no evidence that changes would be institutionalized. A small group of individuals (instructors and postdoctoral scholars) made changes. If new instructors were assigned to a changed course, no data sources suggested that the changes would continue.

Missed Opportunities. In Departments A, C, and E, it was unclear whether changes would be institutionalized. In these departments, the chair was aware of changes but was not actively involved. According to the eight stages, institutionalizing change is the final action taken by the guiding coalition. It would be difficult for the leaders of these departments to complete this stage without being involved in the previous stages. Alternatively, in complexity leadership, institutionalization is an ongoing process. The change initiative participants could have contributed to institutionalization by communicating new course practices to the formal leader and other members in the department. Then, institutionalization could take place based on consensus rather than as the final action of a guiding coalition. In general, the lack of involvement of the chair hindered the ability of participants to institutionalize change.

Potential Activities. In the two more successful departments, the chairs were involved in change. According to the eight stages, the chair's role was to lead the guiding coalition's efforts to institutionalize change. According to complexity leadership, the role of the chair was to align practices with the innovations developed by participants. In Department B, the chair created new expectations for laboratory courses to be inquiry based. In Department D, the chair aligned practices of teaching assignments (co-teaching) with the innovation that was developed by participants to create active-learning modules.

CONCLUSION: CORE OBJECTIVES OF CHANGE AND CHANGE CONTEXT

We have discussed departmental change from the perspective of two change frameworks. These two frameworks identify individual roles and actions to achieve four core change objectives: create vision, motivate participants, build momentum, and institutionalize change. Often the roles of individuals and sequencing of the core objectives are different across change approaches. For example, the strategies for motivating participants occur first in the complexity leadership framework and second in the eight stages. In complexity leadership, motivation is based on the interactivity and interdependency of individuals. In the eight stages, motivation occurs through the allocation of rewards and resources by formal leaders. Conversely, sometimes the enactment of these objectives is similar for both approaches. For example, the formal leadership role in institutionalizing change in both approaches requires leaders to adjust structures within the environment to support changes. Without achieving the goals of these four objectives, change initiatives are not likely to result in sustainable changes.

Fortunately, by using multiple perspectives, a change agent can purposefully select appropriate change strategies to achieve success in these objectives. The change agent begins by reflecting on the process of change. First, the change agent considers the progress of his or her project with respect to the core objectives of change. Next, if one of these objectives has not been achieved, the change agent uses the frameworks to identify types of strategies to achieve the core objective. Finally, the change agent can use this analysis (summarized in Table 5) to identify specific strategies that are appropriate for promoting departmental change. Contextual features help identify which change strategy is the most appropriate. For example, if a change agent identifies a challenge in achieving the core objective of creating vision in a department, he or she may evaluate the relevant departmental context by considering the willingness of formal leaders to form a guiding coalition of key department and institution leaders to identify a sense of urgency and vision before change occurs. On the other hand, a change agent may find that formal leaders are more open to developing interdependency among a small group of willing faculty, for example, to revise a course and develop an emergent vision. As this example demonstrates, the two change frameworks help change agents consider change from a prescribed and emergent perspective to address their contexts. This familiarity provides change agents with multiple tools for promoting change. Moreover, change agents can explore other theories of change to identify strategies and specific activities that complement their context (e.g., Kezar, 2013; Borrego and Henderson, 2014).

The case studies highlight similarities and differences in the change objectives within the context of departmental change. Common activities for creating vision, motivating participants, building momentum, and institutionalizing change, both those enacted and those judged as missed opportunities, are summarized in Table 5.

The eight stages model identifies problems and solutions within the four objectives by focusing on the role of a powerful guiding coalition. This coalition needs to be organized, dedicated, and consistent in guiding change from vision development to institutionalizing change. This focus on formal leaders within a guiding coalition can overlook the power of connections and

Change objective	Eight-stage leadership process activities	Complexity leadership theory activities
Create vision	 Develop a vision that accomplishes things of value, such as developing scientists, preparing undergraduate researchers, or improving mathematics skills. Identify specific course changes to achieve the vision, such as inquiry-based laboratories or authentic research experiences. Include the chair and other informal and formal department leaders (course coordinators, curriculum committee members) in the vision development and promotion. 	 Use new ideas that fit the simple message to articulate the details of a vision. Develop expectations of and opportunities for open, judgment-free discussions at faculty meetings or other departmental gatherings. Remove typical workload or administrative burdens from groups —provide support via postdoctoral scholars.
Motivate participants	 Promote the vision and reward efforts through personal interactions and/or act as role models by piloting course changes in change leaders' classrooms. Provide resources such as money, time, and/or postdoctoral scholar support for initial changes. 	 Use a simple message (e.g., students as scientists) to guide new ideas. Create formal or informal groups of faculty and staff who have a reason to work together, such as coteaching assignments and FLCs. Support teamwork by removing other workloads or providing postdoctoral scholar support.
Build momentum	 Transform initial changes into short-term wins that are celebrated publicly—faculty meetings, departmental newsletters, etc. Continue to identify new areas or new individuals who can be engaged in change (e.g., assign new instructors to changed courses). 	 Enlist support of formal leaders, if possible, to endorse new ideas. Frame discussions about emerging ideas within the simple message. Share emerging ideas broadly—faculty meetings, departmental newsletters, etc. Be involved in informal interactions with group members behind the scenes.
Institutionalize changes	• Engage formal and informal leaders to change structures, such as classroom design, course assignments, or instructional expectations, to support the vision.	• Engage formal and informal leaders to change structures, such as classroom design, course assignments, or instructional expectations, to support the vision.

TABLE 5. Common change agent activities (enacted and missed opportunities) within each change objective

innovation from the other departmental members. In addition, progress within the eight stages is susceptible to abandonment if a turnover in departmental leadership occurs. To mitigate this challenge, both formal and informal leaders should be included in all phases of the project and not just brought in after the vision has been created. Participants need to be motivated through both interpersonal interactions and provision of resources. It is also important to plan for building momentum. This involves both giving credit to good work accomplished by current participants and seeking out ways to involve more people.

Complexity leadership theory requires that department members are fully engaged in all aspects of the change process. Specifically, change should start with motivation to change through disruption of events and interdependency between individuals. It is often desirable to develop a simple message to guide the project and motivate participation. Change agents who use the complexity leadership approach may be tempted to overlook the important role of formal leaders. These leaders are in the best position to create an environment that supports interactions and to be open to the development of new ideas. Formal leaders are typically happy to support change efforts that are aligned with their goals. Thus, it is important for change agents to articulate how work toward the simple rule aligns with institutional priorities. Interpretation of emerging ideas is another area where change agents need to pay attention. Much behind-the-scenes work is needed to enhance communication among project participants as well as between project participants and other key stakeholders.

Across both frameworks, the informal and formal leaders of the department, often the department chair, have an important role. If the department chair is not supportive of change, then a change agent may need to think of creative ways to address the core objectives. The change that was supported by the members of the specialization in Department A is an example of how interactions of faculty can support change when the chair is not involved. In addition to gaining the leader's support, the change agent must remember that the departmental leaders will likely also need guidance on what type of support to provide. For example, based on the context of the department, this support may take the form of promoting a vision or creating reasons for faculty to work together on teaching projects. The frameworks identify when the departmental leaders should be involved in change and what type of strategies should guide their actions.

The departments in the case studies were all sited in the same research, doctorate-granting university. Change agents who are working at institutions with different characteristics (e.g., community colleges) will need to extrapolate the main features of the suggested activities for application in their contexts. For example, community colleges will probably not have postdoctoral scholars to provide support to motivate participants to become involved in change. The necessary aspect of this strategy is support. Instead of postdoctoral scholars, community colleges may have to identify other sources of support, perhaps funding for a course coordinator who could play a similar role as the postdoctoral scholar or online asynchronous communities that can fit into the schedule of faculty members. In this way, a change agent can use familiarity with various strategies for achieving the core objectives of change to identify specific activities that are suitable for the local context of his or her institution.

Categorizing the core objectives of change helps a change agent identify key players and plan actions to guide the change process. In addition, the objectives can be used to diagnose challenges (missed opportunities) to change and to suggest potential solutions. These case studies provide specific examples of key players, actions, and activities that might be used in a department to promote instructional change. Through familiarity with multiple perspectives on change, a change agent can plan change that matches the context of his or her department and use multiple tools to increase the likelihood of successful change efforts.

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