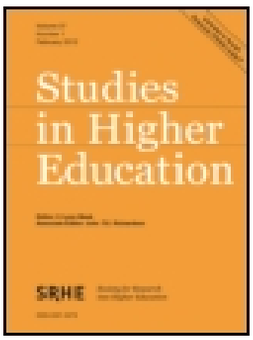

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Guiding change in higher education: an emergent, iterative application of Kotter's change model

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ABSTRACT

While university change initiatives have become more common in the face of changing learner needs and higher education funding, many fail to produce desired effects, even when guided by organizational change models. The purpose of this study was to document a successful change process in an engineering department at a Hispanic-serving institution in the southwestern United States. The change effort focused on enhancing faculty capacity to support diverse student success. The change process was planned using Kotter's eight-step change model (1996) and was therefore a prescribed, linear, sequential change process. Qualitative analysis of audio-recorded faculty interviews and meetings, artifacts, field notes, and participant observation highlights how Kotter's change model was implemented iteratively and emergently. Early steps were revisited and strategies were treated as improvable. This approach enhanced faculty buy-in and project success. Characterization of each step provides insight into ways to apply Kotter's change model in higher education settings.

KEYWORDS

Faculty development; Kotter's change model; engineering education; higher education; design-based implementation research

Introduction

In higher education, as institutional change initiatives have become increasingly common, it is notable that many fail (Kezar 2011). Such efforts may be stymied by ineffective leadership, faculty reluctance, financial tensions, public scrutiny, competing values, and conservative institutional traditions (Kezar 2001; Klempin and Karp 2018). In contrast to other organizations, higher education institutions are also distinctive in their shared governance, tenure and promotion systems, and multiple power structures, often with multiple or ambiguous goals (Kezar 2011). Because of these characteristics, change models that are political, cultural, or sociocognitive, rather than simply teleological may be more effective (Kezar 2001), and the complexity of higher education settings may warrant a more adaptable approach (Quan et al. 2019). Teleological models are commonplace outside higher education and are characterized as pre-planned, top-down, and linear with a clear, deterministic vision that is defined at the outset (Van de Ven and Sun 2011). However, faculty possess a significant amount of autonomy, so top-down approaches may not be effective (Buller 2015). Yet, teleological models hold appeal because of their concreteness and accessibility to those who are outside the change management field, but who are central to the actual change process (Guzmán et al. 2011; Wentworth, Behson, and Kelley 2018).

This paper reports on a project that adapted a teleological approach – Kotter's change model (1996) to manage a major change process in an engineering department at a Hispanic-serving

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research university in the southwestern United States. This four-year effort involved an interdisciplinary team of administrators and faculty from engineering, learning sciences and change management.

Literature review

Kotter's change model

Kotter's change model is one of the best-known frameworks for change management (1996). Because it is regarded as a simple and straightforward framework, many practitioners continue to implement it (Borrego and Henderson 2014; Pollack and Pollack 2015; Wentworth, Behson, and Kelley 2018). Kotter's change model comprises eight steps (Kotter 1996): (1) *Create a sense of urgency*. Major change requires more effort than business as usual (Cohen 2005) and informing people of the urgent need for change helps them get ready for it (Kotter and Cohen 2002). (2) *Build a guiding coalition*. If the first step is implemented successfully, people who have the right knowledge, skills, and authority will be inclined to join the change process (Kotter and Cohen 2002). Success depends on having the right people on the team (Collins 2001), including effective leaders (Bystydzienski et al. 2017; Kotter 2008; Quardokus Fisher and Henderson 2018). (3) *Form a strategic vision for change*. Building a strategic vision guides the change process toward a shared, known, and desirable new state. This vision must be paired with appropriate, feasible, and effective strategies for achieving it (Cohen 2005; Graham 2012; Senge et al. 2012). (4) *Communicate the vision*. Major change is successful only when people buy-in and drive in the same direction (Besterfield-Sacre et al. 2014). (5) *Remove obstacles*. Before the full-scale change can take effect, possible barriers to change must be identified and removed (Cohen 2005). (6) *Create short-term wins*. In the process of the change, celebrating minor victories along the way can serve as an emotional reward, creating momentum for success (Cohen 2005; Kotter and Cohen 2002). (7) *Consolidate improvements*. As the change occurs, members sometimes lose their sense of urgency, become exhausted, or fall back into old routines (Kotter and Cohen 2002). In order to prevent these situations, the change needs to be continuously monitored and refined to ensure everyone stays passionately involved (Cohen 2005). (8) *Anchor the changes*. When the change is institutionalized and becomes routine to people, and the knowledge, skills, and attitudes have been disseminated, it can be viewed as successful (Cohen 2005).

Kotter's change model in higher education institutions

Kotter's change model has been used to successfully guide or account for change in higher education settings, but generally related to administrative and technological changes. For instance, Wentworth, Behson, and Kelley (2018) reported on their use of Kotter's change model to replace a teaching evaluation system. They attributed their success to their adherence to Kotter's steps, but also explained how these steps fit within a higher education context. They noted the importance of including members elected by the faculty on the guiding team as a means to fit within the shared governance model and gain faculty buy-in. When communicating the vision to faculty, they helped faculty understand how the new system could provide benefits in tenure and promotion processes, including by providing faculty with more useful and timely feedback. Likewise, they took care to be transparent in communicating how and why they chose a specific system. Similarly, driven by nationwide changes to dental education, a dental school found success using Kotter's change model to overhaul their approach to assessing student and program clinical outcomes (Guzmán et al. 2011). Their success hinged on aligning to incentive systems, including offering continuing education credits to involved faculty, and rolling out the new system through smaller pilot implementations as a means to build faculty trust.

Kotter's change model was used to change faculty participation in accreditation activities of a business school (Calegari, Sibley, and Turner 2015). While their efforts were successful, they noted

that Kotter's change model provided insufficient guidance on gaining faculty buy-in. Like Wentworth, Behson, and Kelley (2018), they noted the importance of transparency and communication. They also found faculty needed to be re-engaged following a short-term win. Similarly, analysis of a top-down effort to integrate instructional technology and library services found that when faculty felt such wins were artificial, this hindered their progress (Sidorko 2008).

Kotter's change model has also been used to guide culture change in a school of nursing. A sense of urgency was created by using a climate assessment, which revealed a culture of distrust and incivility. While limited detail is provided about how Kotter's model was applied, Springer et al. (2012) noted that they followed all steps and, like others have noted, that shared governance was an important aspect.

Study purpose

Across the examples of Kotter's change model discussed, we note that the roles of buy-in and short-term wins appear salient. Successful change projects that involved faculty found ways to gain their buy-in, such as through shared governance models and careful consideration of faculty incentive systems. In contrast to business settings, artificial wins and even authentic wins can de-motivate faculty if they are not deeply invested in the vision. However, few examples, even from higher education, provide clarity about how this model might be used to bring about changes in department culture and curriculum. For instance, while a medical residency program that used Kotter's model demonstrated significant improvements in student perceptions, the brevity of that publications (three pages of text) does not provide insight into the process or how the challenges encountered were mitigated (Haas et al. 2020), though such accounts provide additional motivation for understanding the change process. Others have noted this gap recently, calling for studies that investigate 'how Kotter's eight stages are interpreted within a change effort' in higher education (Wentworth, Behson, and Kelley 2018, 11).

In addition to needing to understand the potential of Kotter's change model as a guide for such settings, more information is also needed about 'key contextual factors' (Wentworth, Behson, and Kelley 2018, 11). In order to make sense of contextual factors identified in a single enactment, we leverage a framework based on analysis of departments engaged in change processes (Reinholz et al. 2019): (1) structures, which are 'formal roles, responsibilities, practices' that 'organize who interacts and how' (3); (2) symbols, which include disciplinary norms and ways of knowing; (3) people, including staff and students; and (4) power, including systems of oppression and decision-making. Using this framework, they identified similarities and differences across science and mathematics departments; below, we note that some of these are and are not salient in our engineering department – and in engineering (and academic) departments broadly.

In terms of similar structures, they found that such departments have high enrollment lower division, service courses, labs focus on teaching techniques, each course has set core concepts, and faculty expectations outside of teaching include service and grant-seeking (Reinholz et al. 2019). While the latter three are characteristic of our context and common to many engineering programs, few engineering courses act as service courses. Likewise, engineering labs, which typically occur after students have gained basic laboratory skills in their science prerequisites, tend to focus on understanding and directing the research process and nature of engineering research, while applying core content. Structural differences they identified that are salient for engineering departments included course ownership, departmental structure (e.g. programs), how teaching assignments are decided, and how departments are managed.

In terms of similarities in symbols, they found disciplines have reputations tied to their difficulty and are organized by subdiscipline, and that teaching involves conveying disciplinary knowledge, typically through knowledge acquisition (lecture), though there were also differences identified related to teaching (Reinholz et al. 2019). These include the degree to which technology was used and whether teaching also prioritized theory and application. All of these similarities and differences

are also salient for engineering programs, but some may not be salient for academic disciplines outside of STEM, particularly related to disciplinary norms in teaching.

In terms of people, they found the same types of roles, including undergraduate and graduate students, postdoctoral scholars, staff, tenure- and non-tenure-track faculty, and administrators, with individuals affiliating with particular sub disciplines (Reinholz et al. 2019). They identified differences in the percentage of non-tenure-line and teaching-focused faculty and the role of graduate students, including their involvement in teaching versus research. All of these similarities and differences are also salient for engineering programs, and likely for academic programs broadly (though graduate student roles are salient only for graduate-degree granting programs).

In terms of power, across settings they noted that white men have more power, that extramural funding provides status, that senior and tenured faculty have more power than others, and that research is viewed as more prestigious than teaching. They also noted that subdisciplines compete for power, but that disciplinary perceptions of what constituted status in the field varied by discipline (Reinholz et al. 2019). With almost no differences noted, these similarities are also generally salient in academic departments.

While we consider structures, symbols, people and power generally, based on these characteristics, we particularly orient to the following: (1) departmental structure and management; (2) which disciplinary symbols are prioritized and how they are transmitted to undergraduate students; (3) the composition of the department and the guiding team, and especially those involved in undergraduate teaching; and (4) the role of extramural funding, seniority, disciplinary hierarchy (i.e. learning sciences and engineering education versus technical engineering fields), and research versus teaching. Using these as an analytical lens, our study addresses gaps in understanding by identifing key contextual factors salient in this process and detailing how Kotter's change model has been used and understood by faculty involved in a major departmental change effort. To guide our research, we addressed the following questions:

(1) How did an interdisciplinary team employ and adapt Kotter's change model to plan and manage a change process in an engineering department, especially given noted challenges to using a teleological change model in higher education settings? Specifically, considering that Kotter's model is characterized as:
    - an accessible model that scaffolds those outside the change management field to participate;
    - a top-down approach that conflicts with faculty autonomy and shared governance;
    - a linear, deterministic approach that may not be effective in complex settings
(2) In what ways do the eight steps of Kotter's change model fit into a particular higher education departmental setting, in light of contextual structures, symbols, people, and power? Specifically:
    - Structure: What is the role of departmental structure and management?
    - Symbols: Which disciplinary symbols are prioritized and how they are transmitted to undergraduate students?
    - People: What is the composition of the department and the guiding team, and especially those involved in undergraduate teaching?
    - Power: What is the role of extramural funding, seniority, disciplinary hierarchy (i.e. learning sciences and engineering education versus technical engineering fields), and research versus teaching?

Methodology

While we used Kotter's change model to guide the change process, our research has been conducted as design-based implementation research (DBIR, Fishman et al. 2013). In this approach, researchers and members of an organization aim to understand and address a persistent problem of practice – in our case, inequitable retention of students from diverse groups and inadequate professional

preparation for their careers. DBIR studies typically emphasize iteration. In an example study, a curriculum reform process at a medical school involved five iterations of design, implementation, reflection, and revision, a process that not only served to improve the curriculum, but also support faculty to understand more about how their students learn (Chen, Worden, and Bradley 2015). In this example, we see, thus, why a goal of DBIR is developing capacity for sustaining change (Fishman et al. 2013): as faculty gain increased understanding of learning, they are able to continue to adapt as new issues emerge (Chen, Worden, and Bradley 2015).

Publications reporting on DBIR – a relatively recent expansion of a well-established methodology in the learning sciences (design-based research) – tend to report illustrations of the methodology, report on the degree to which the persistent problem has been understood and addressed, or, as in our study, report retrospective analysis of insights gained about the change process. In all such accounts, results and discussion are typically intertwined, and we follow this convention.

Setting and participants

Our study documented planned change activities in an engineering department at a Hispanic-serving research university in the southwest United States. The engineering department included 14 faculty who commonly teach in the undergraduate program (one of whom is not tenure-line) and nine faculty whose prior interaction with undergraduates was limited to participation in their research labs. The core team includes nine members: the department chair, three disciplinary faculty, a writing specialist, a postdoctoral scholar, a learning scientist with expertise in engineering education, a consultant with expertise in engineering education and assessment, and a specialist in change management. The chair and the latter three led the project.

Data collection and analysis

Our data corpus documents the evolution of the project, from early team formation through three years of implementation. We recorded interviews with a subset of faculty about their perceptions undergraduate teaching and advising; their sense of a need to change undergraduate teaching; their understanding and perceptions of project activities, including design challenges, digital badges, and students' technical writing competency; and their concerns and suggestions (Table 1).

Additionally, audio records of departmental meetings provided an opportunity to witness faculty making decisions that directly related to project aims. Recordings included nine professional development workshops, to which all departmental faculty were invited and three half-day faculty retreats. Artifacts (e.g. proposal drafts, emails, handouts, design work), participant observations and field notes provided contextual information.

We transcribed recorded data and employed a stepwise top-down coding approach to analyze the transcripts with a systematic and recursive collaborative coding plan (LeCompte and Schensul 2010). We developed an initial coding framework based on the eight steps of Kotter's change model (Table 2), followed by three cycles of initial coding, pattern coding, and post-coding. In the initial coding, each team member coded the data line-by-line, highlighting codeable moments (Saldaña 2015). In pattern coding, each researcher then analyzed data across transcripts focused on two of Kotter's steps and provided a summary structured by three questions: (1) What did the data tell

Table 1. Schedule of interviews.

Timing	Interviewees
4 months into implementation year 1	3 faculty (A, B, C)
3 months into implementation year 2	5 faculty (D*, E*, F, G, H)
6 months into implementation year 2	2 faculty (I*, J*) and 1 non-faculty member (K*)
1 month into implementation year 3	2 faculty (E*, J*) and 1 staff

*Member of guiding team

Table 2. Operationalization of Kotter's change model as coding framework.

Code	Positive	Negative
Create a sense of urgency	Expresses need for change or concerns about undergraduate matters (students, curriculum, teaching, program).	Expresses complacency or satisfaction with undergraduate matters.
Building a guiding team	Mentions having right people in the team, strong leadership, requisite expertise; well managed and organized. Team effectively divides work and trusts each other.	Mentions team includes inappropriate people, lack of leadership, lack of trust.
Form strategic vision & strategies	Mentions vision of possible future, what changes are needed to get there. Vision appeals to stakeholders and is supported by aligned strategies.	Mentions lack of clear vision; no plan for reaching vision; vision is not appealing to stakeholders; visions and strategies are not aligned.
Communicate vision to enlist volunteer army	Mentions use of multiple forums to communicate vision, opportunity to give feedback on the change, two-way communication; understands vision, strategies, and project progress.	Mentions that communication is infrequent, one-way; does not understand vision, strategies and project progress.
Remove obstacles	Mentions a barrier removed, trying new innovative teaching, empowered by faculty development.	Mentions barriers that prevent trying new teaching (policies, skills, beliefs, etc.).
Create short-term wins	Mentions a clear win or celebration of a win, or plans for future wins.	Does not mention wins or that wins are not celebrated, lack of plan for future wins.
Consolidate improvements & sustain acceleration	Mentions short term wins are leveraged for bigger initiatives; faculty buy in more; changes in own teaching	Faculty adoption is not growing; core team allows urgency to decrease
Anchor the change	Mentions that change is a new normal; succession plans exist, lessons learned are disseminated	Expresses 'us vs. them' discourse between faculty and the core team; succession plans ignored; lessons learned not disseminated

you about this step? (2) Did you find any nuances from coding this step? and (3) What conclusions did you draw from this specific category?

Establishing trustworthiness of qualitative data

We employed six methods to limit systematic biases and chance associations as a means to establish the trustworthiness of data collection and analysis: intensive involvement, purposeful sampling, triangulation, individual coding, peer scrutiny, and respondent validation (Maxwell 2013). Additionally, we quote comments verbatim to ensure we have not changed their meaning. (1) *Intensive involvement*. The learning scientist has been involved with the project since its initial inception in 2014 and the specialist in change management since 2015, both serving as co-PIs of the project. They participated regularly in project planning, management, and department meetings. Their repeated observations and sustained presence in the research setting helped reduce spurious inferences. (2) *Purposeful sampling*. We selected participants purposefully to capture the heterogeneity in the department, interviewing members from the core team as well as departmental faculty with varying levels of engagement with undergraduate courses. This allowed us to compare different points of view. (3) *Triangulation*. Triangulation of findings across data sources provided more credibility and reduced the potential biases of using a single data source. (4) *Individual coding*. To reduce individual bias, each member individually coded transcripts, kept their own analytic memos, and documented the patterns they noted from their analysis prior to group analysis. (5) *Peer scrutiny and debriefing*. We resolved ambiguity collaboratively and crosschecked inferences as a team, finding a high degree of agreement at the level of codes and patterns. (6) *Respondent validation*. Members external to the analysis team provided member checks on interpretation.

Results and discussion

We organize our findings by research question and consider our findings in light of past research on Kotter's change model in higher education.

RQ1: using Kotter's change model

We report on analysis of how the team used Kotter's change model to plan and guide a change process, from team formation and project planning, through early and later project work (Figure 1). Overall, we found the change process has been non-linear and iterative.

Project planning

The project was initiated by a National Science Foundation (NSF) call for proposals in 2014 to 'revolutionize' how engineering is taught. The departmental chair recruited a learning scientist, explaining 'I feel your background in education would help us. … I polled our faculty and find them to be uniformly supportive.' While the call for proposals created a sense of urgency, our first attempt at proposal preparation was not guided by a change framework. Despite this, the process aligned well to the first steps of Kotter's change model. The initial project team began by creating a sense of urgency by identifying gaps between the desired and actual state of affairs in the department, as required by the grant. This effort included, as suggested by others (Finelli, Daly, and Richardson 2014), collecting data from faculty, observing classroom teaching, and surveying students. Gaps were communicated to stakeholders, leading to agreement about the need for change. However, the proposed project did not take into account the complexity of change process and did not provide clarity about intermediate steps en route to change, and the project was not funded.

During the second attempt, a new guiding team was formed, including a member with expertise in change management who suggested Kotter's change model, in part because of the accessibility of the steps to those outside the change management field (Wentworth, Behson, and Kelley 2018). The team requirements from NSF mirrored Kotter's guidelines – that teams need members with the right knowledge, positions, and authority (1996). The team drafted the grant proposal together, and this

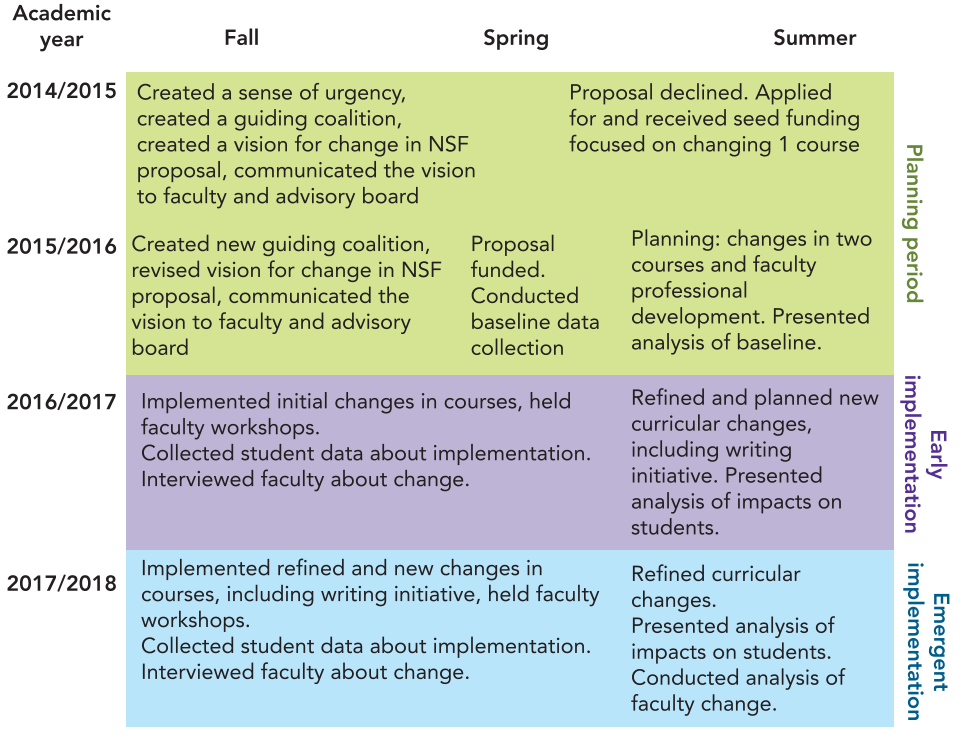

Figure 1. Overview of activities in the broad three phases: an initial planning period, early implementation of the change following what was proposed, and an emergent implementation period that deviated from what was initially proposed.

served as an opportunity to form a vision – developing faculty capable of supporting diverse student success in engineering, and change strategies – providing professional development workshops, conducting collaborative engineering education research on the effects of integrating design challenges into core courses, and leveraging a digital badging system as a tool for faculty to consider meaningful assignments and assessment practices. To establish buy-in, the guiding team held discussions at faculty meetings and two well-attended professional development workshops and communicated the vision and strategies to stakeholders (Cohen 2005), who found them worth pursuing; this served as a validation of our use of Kotter's model, as others are willing to join if the initial steps are followed well (Kotter and Cohen 2002). As planned, the project was highly linear and followed Kotter's change model (Figure 2).

At this stage in the project, a teleological change model fit well because of its accessibility, and also because of the nature of grant proposals. It is relatively common for proposed work to be modified as new insights come to light, meaning faculty might not have perceived the plan as deterministic (Van de Ven and Sun 2011). Thus, at this stage, Kotter's model provided needed clarity without prompting concern from faculty related to their autonomy (Buller 2015).

Early project implementation

After the grant was awarded, the team worked to remove barriers (Cohen 2005). For instance, they negotiated with the dean to change the status of engineering education research. Prior to the project,

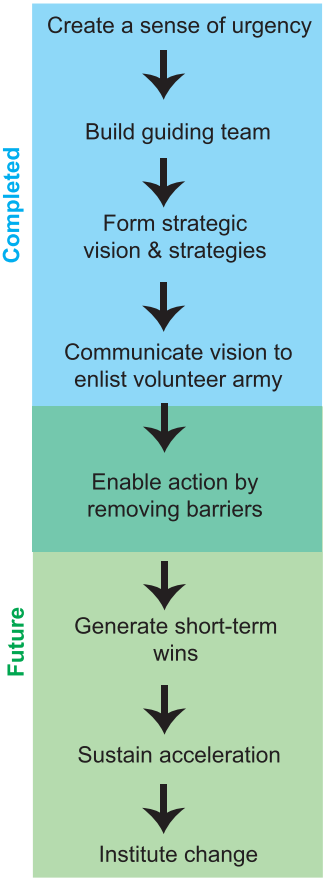

Figure 2. The initial planned change process from our second grant proposal depicted a slightly modified yet highly linear change process based on Kotter's change model (1996).

such publications counted toward teaching in the promotion and tenure review process. To help faculty see such efforts as valued, these now count towards research. This is similar to the argument by Wentworth, Behson, and Kelley (2018) who found that in higher education settings, linking a change effort – in their case, a new teaching evaluation system – to the tenure and promotion system was a key to success.

In an effort to be transparent and build additional buy-in, the team communicated the vision to many stakeholders (e.g. the dean, provost, and faculty development office staff). In these communications, an updated version of Kotter's change model was shared, seeding the potential for iteration by representing three middle steps as 'ongoing' (Figure 3) and likely reinforcing the notion that planned grant projects may change, rather than being deterministic (Van de Ven and Sun 2011). The team discussed the project at a faculty retreat just before project implementation began. While the department chair was enthusiastic, one member of the guiding team expressed concerns about the extent of curriculum change. This modeling of faculty autonomy (Buller 2015) by a guiding team member led other faculty to express concerns; yet, these also revealed critical leverage points, as faculty expressed concerns that students were not gaining what they needed through traditional means.

Faculty who were part of the guiding team worked closely with the learning scientist to develop, implement, and study the impact of design challenges in their classes. During this time, the team celebrated an early win – a best paper award, which provided external validation and led more faculty to be interested in participating in engineering education research. By participating, members of the guiding team saw the value of the change strategies, enhancing their buy-in. The buy-in of the guiding team is typically treated as needing attention only at the beginning of a change project, but given the aforementioned autonomy displayed by a guiding team member (Buller 2015), our data suggest ongoing attention to buy-in and ways the change strategies may impact buy-in may be salient for change in academic settings.

Emergent project work

Reflective of the autonomy (Buller 2015) and lack of expectations for determinism (Van de Ven and Sun 2011) among faculty, one year into the project, a member of the guiding team raised concerns

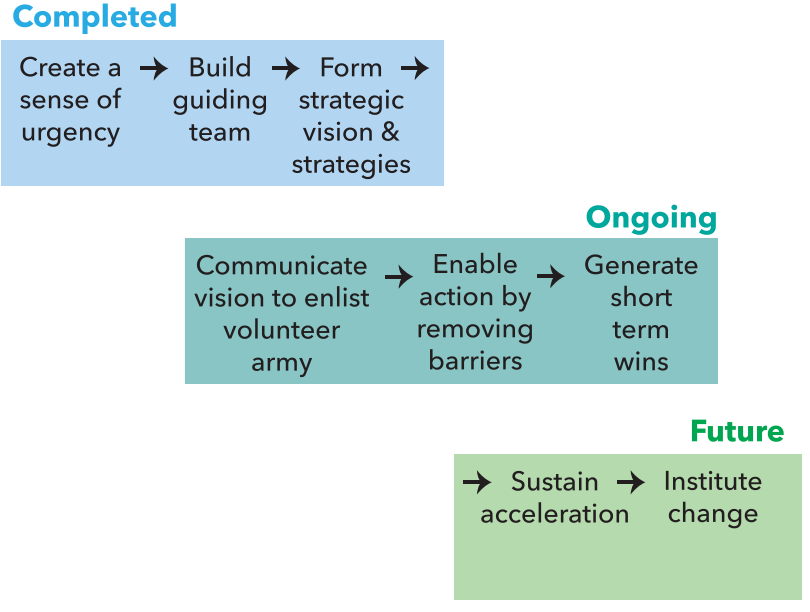

Figure 3. Depiction of our change process from early in the project, seeding the roots of iteration by depicting the middle stages as ongoing.

about the quality of students' writing. The team decided to incorporate this as a new strategy, ultimately adding a new member to the team. Thus, while the vision remained, the strategies and guiding team changed. By responding to an emergent concern, the buy-in of the team members deepened, with several members contributing to engineering education research for the first time. This was depicted as an iterative representation of Kotter's change model in a presentation given one and a half years into the project (Figure 4) and aligns to insights that the complexity of department change warrants an adaptable approach (Quan et al. 2019).

By early in the second year of the project, faculty members' – including those not on the guiding team – buy-in increased, as evidenced in their ability to speak positively and at length about the project in interviews. They expressed support for two central goals of the project – the retention of diverse students and helping these students establish their identities as chemical engineers. For several faculty, incorporating a new strategy – enhancing writing – increased their sense of ownership of the change.

Ours is not the first reported adaptive use of Kotter's change model reported in the literature. Pollack and Pollack (2015) adapted Kotter's change model for an organization that had groups with different levels of power and engagement. They retained the linear sequence of steps, but did so semi-concurrently with the different groups. The process was compressed with some groups and drawn out and overlapping with others. Likewise, the change process described in Guzmán et al. (2011) is suggestive of an iterative approach, as they concisely mention changes based on pilot testing. Perhaps because of a felt need to fit into the linear structure of the model, we get little sense of how this actually occurred.

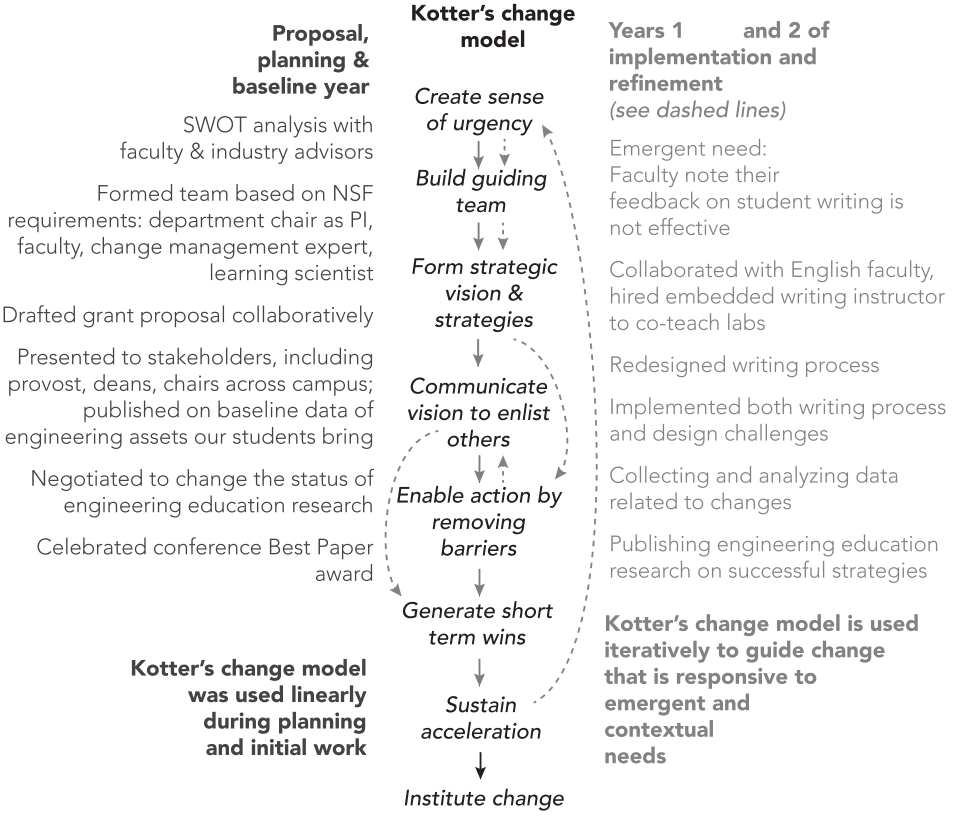

Figure 4. Depiction of change process as it occurred one year into the project.

However, our approach appears to be the first reported use of Kotter's model that incorporates iteration and a non-linear approach, treating the steps as revisitable and revisable rather than deterministic (Van de Ven and Sun 2011). This addressed noted limitations of typical uses of Kotter's model while retaining its accessibility.

Our approach may have been influenced by our use of DBIR, a research method that encourages iteration; more specifically, DBIR involves cycles of implementation and documentation of a newly designed practice in an organization, followed by reflection, refinement, and revision (Fishman et al. 2013), a process that surfaces and responds to emergent issues (Chen, Worden, and Bradley 2015). Thus, following this research model encouraged us to reflect and suggest revisions based on emergent issues and insights. However, as we had chosen a top-down, linear change model, the decision to act on such suggestions could have remained with the department chair, who might have seen value in simply following the process as planned. It is also important to note that changes to strategies – namely, incorporating a focus on technical writing – were not a simple refinement of approach as would be seen in DBIR. By deciding to revisit steps and revise or improve on them, we aligned to the needs of higher education settings. Specifically, departmental change is challenging because faculty are used to having a high degree of autonomy and expect shared governance (Buller 2015; Springer et al. 2012). In order to get faculty to feel a sense of ownership over change, it is important to align to these expectations. Revisiting previous steps refined the strategies in ways that included more faculty. Thus, although classified as a teleological model (Van de Ven and Sun 2011), we used Kotter's model emergently, much like complexity leadership theory, in which change follows an adaptive process where multiple members are motivated to innovate and contribute to change (Quardokus Fisher and Henderson 2018; Uhl-Bien, Marion, and McKelvey 2007).

RQ2: evaluating the fit of Kotter's eight steps in higher education

We characterize each step to provide clarity about our particular use of Kotter's change model in higher education and consider contextual factors (structures, symbols, people, power) that shaped each step (Reinholz et al. 2019). We include direct quotations, noting whether the speaker was a guiding team member (GT), a faculty member who commonly taught in the undergraduate program but was not on the guiding team (FacUnd) or who seldom interacted with undergraduate students (FacGrad). We also note the timing (planning periods 1 and 2 = PP1, PP2; implementation years = I1, I2, I3).

Step 1: creating a sense of urgency

For departmental change to be successful, the need for change should be broad enough that most faculty can agree that it is a need (Springer et al. 2012). However, based on our analysis, a felt sense of urgency can be manufactured by aligning to a commonplace power structure – a grant deadline. The call for proposals inspired the chair to 'think outside the box' and 'help this department to do better' (GT, I2). Most faculty believed the education of undergraduate students was central to the department's mission ('our PRImary mission is to – is to train the next generation,' FacUnd, I2) and that there was a need for change in the undergraduate curriculum, though faculty expressed their sense of the need for change in ways reflective of disciplinary symbols (Reinholz et al. 2019): (1) the curriculum did not sufficiently promote professional skills; (2) modern engineering problems, techniques, and practices have changed since the textbooks were developed; (3) the students were unable to apply knowledge acquired in courses to 'real-world' engineering problems; (4) diverse students were not being retained at similar levels to their peers from groups well-represented in engineering; and (5) traditional teacher-centered, 'archaic' (FacUnd, I1) approaches to instruction contribute to many of these issues.

The idea that a sense of urgency for change can be created by a grant deadline is reinforced by data from implementation year three, when a call for proposals for replication grants came out. Two members of the guiding team who were initially less enthusiastic at the start of our project led the

effort to identify a partner and mentor them about writing such a proposal, including that the 'proposal would look very different from most engineering proposals.' When the change is tied, as in our case, to a major grant opportunity – a powerful incentive in higher education – faculty may agree to participate for a range of reasons (e.g. tenure and promotion, summer salary, interest in the project). In the absence of such incentivizes, other efforts may be important. For instance, a dental school expended significant time and effort to understand faculty beliefs and practices before forming a guiding team (Guzmán et al. 2011). For our context, the step of creating a sense of urgency was a relatively simple threshold, and one that not all faculty needed to be a part of.

Step 2: building a guiding team

Because the unit of change was a department, the department chair was a logical leader (Quardokus Fisher and Henderson 2018). The chair played a significant role in forming, leading, and managing the team. Guiding team members were confident in the department chair's leadership and management, explaining the chair 'was very smart in planning the project to get as – as many of us involved as possible' (GT, I2). One joked, 'I was kind of dragged onto the team' because of their role in the department (GT, I2), but members of the guiding team were cognizant of why they were asked to be part of the team (e.g. 'my involvement was more natural, because I was in charge of ABET' [GT, I2]; 'I was involved because I was the new undergraduate program director' [GT, I2]). The learning scientist was quick to assess and find the chair to be open to collaborating and learning; disciplinary hierarchies between engineering and social/behavioral science fields can be a barrier to this. Thus, forming a guiding team was relatively straightforward, in part because of guidelines provided by NSF and in part because of the structures already present in the department. Revisiting the team composition as the strategies changed allowed us to maintain the needed expertise. Had the unit of change been larger than a department, extra effort to identify leaders with the needed knowledge, skills, mindset, and authority would have been required (Springer et al. 2012). Had the faculty doubted the chair's capacity to manage the department, they may not have been willing to participate, though had this been the case, they also may not have been willing to serve in such departmental roles. The chair's openness to collaborating across disciplinary boundaries created an opportunity for the team to shape effective strategies.

Step 3: forming strategic vision and strategies

In higher education settings, forming strategic vision and strategies is familiar work for faculty who regularly submit grant proposals. However, given the autonomy faculty are accustomed to (Buller 2015), forming a *shared* vision, especially given the notably broad and multifaceted nature of faculty perceptions about the need for change, can present challenges (Kezar 2011). While the learning scientist suggested strategies, faculty also suggested ideas, which the learning scientist vetted. The guiding team met frequently to develop consensus, but the strategies were initially primarily developed by the chair and learning scientist. Although the team members showed approval and appreciation, they left ownership of the project with the chair and learning scientist prior to the project beginning. As an example, one of the members was enthusiastic about what the learning scientist had written ('loving reading all the pieces you wrote!') and later, after creating a couple figures, this member wrote 'you can decide whether you want to use the figures or not' (GT, PP2). Members provided critical feedback, however, leading to a stronger proposal ('the idea of [the design challenges], what it is and how it will help students learn and persist … I wonder if we need a little more detail on an actual design challenge' GT, PP2).

Ultimately, the guiding team accomplished a shared initial vision ('we all agree on what we are trying to achieve,' GT, I2). However, the vision and strategies have been treated as improvable and revisable during the change process, evidenced by the added focus on teaching writing. We argue that this aligns with the culture of academic departments – where much of the research faculty do involves iterative refinement. This alignment fostered a sense of shared ownership over the change process (Springer et al. 2012).

Step 4: communicating vision to enlist a volunteer army

Kotter (1996) emphasized that a range of communication vehicles should be used and that the guiding team should model the change. Neither of these was directly applicable in our context. Past research has emphasized that Kotter's change model does not provide sufficient guidance about gaining faculty buy-in (Calegari, Sibley, and Turner 2015). In contrast to organizations, university departments typically have common listservs and meeting times, with all members in attendance. The chair frequently put the change strategies on agendas. Professional development workshops provided additional opportunities for faculty to learn about the strategies. Thus, compared to organizations, communication was straightforward.

Having the guiding team model the change was impractical for two key reasons. First, faculty seldom observe one another teaching. Second, the change strategies were unfamiliar to the engineering faculty on the guiding team, meaning they also needed support to implement them. It is unsurprising, then, that at the beginning of the second year of implementation, some faculty indicated inadequate communication about the strategies. One faculty member stated that 'no one's actually fully explained to me the full scope' of the project (FacGrad, I2). Another noted that attending a workshop on digital badges did not provide sufficient understanding ('Well, so I only understand those in the sense of, again, having been too, I guess, a workshop where the topic was discussed' FacUnd, I2). We argue that this uncertainty was hard to avoid because it was tied to long-held symbolic knowledge. Even though the strategies were communicated, we were asking faculty to implement strategies that were unfamiliar to them. While it may seem ideal to have instead invested time and effort providing professional development about the strategies – meaning changing faculty beliefs and practices related to disciplinary symbols in the form of priorities in and approaches to teaching – it is clear from both the practice of education developers and research on how people learn that this ideal is unrealistic. Faculty who show up ready to learn at professional development workshops do not represent the all campus faculty, but rather those who are ready to change. Research on learning has clarified the importance of having a need-to-know to motivate understanding (Bransford, Brown, and Cocking 2000). In this way, we think efforts may be better spent on gaining shared understanding over time, rather than instilling in all faculty a sense of urgency for the change. Had we focused more effort on creating a sense of urgency with faculty who lacked understanding about how to support learning, this may have led to very different strategies, such as deficit-oriented policy changes (e.g. raising the bar for entrance and progress through the program) or changing who teaches undergraduates (e.g. adjuncts rather than research-active faculty). Or, we might have alienated hesitant faculty. By gradually building shared understanding with guidance from the learning scientist – a strategy reflective of the DBIR approach, which typically involves committed collaborative work between members of the organization and researchers with expertise related to the desired change (Fishman et al. 2013) – their lack of experience with the strategies was an obstacle to change that was removed over time.

Step 5: removing obstacles

Guiding teams commonly must remove obstacles (Kotter 1996). The first major obstacle removed involved a power change at the School level – counting engineering education research towards scholarship, rather than teaching, in promotion and tenure decisions. While this made faculty more interested in engaging in such research, inexperience with new strategies was a major obstacle. As one faculty explained, teaching design challenges 'take[s] me away from my comfort zone, which is lecturing' (FacGrad, I2). This is not surprising, as the expectations and criteria used in new faculty hires at research universities tend to discourage prospective faculty from gaining teaching experience prior to their first appointment. And once in their first appointment, they typically replicate the teaching they experienced – this is what makes disciplinary forms of teaching identifiable as symbolic knowledge. To overcome this obstacle, we provided time, expertise, and resources – including people with the needed expertise – to support faculty to make changes.

To incentivize participation during the grant, faculty were provided with summer salary and peer learning facilitators (undergraduate students) to support the development and implementation of design challenges. This jointly elucidated symbol, people, power aspects, as previously, when undergraduates were involved, they served only as graders, not as co-designers with power to impact how and what information was conveyed to students. When faculty implemented design challenges and the new writing approach, they more fully bought into the change. For instance, one faculty member reflected on their changing beliefs related to symbols 'I had a very traditional, uh, uh philosophy that chemical engineering should be taught in a very formal traditional fashion, and, and now I, I would say that, that I'm, um, more flexible to change in that' (FacUnd, I1). In higher education, understanding reward structures is important when considering ways to remove obstacles to change (Kezar 2011). One faculty characterized this, explaining 'at least as important as financial [incentives] is an acknowledgement that it's important, that the contribution is valued' (FacUnd, I2). For this reason, we found authentic short-term wins to be a critical means to show that contributions to the change process were valued, fostering further buy-in.

Step 6: creating short-term wins

Sharing successes in the middle of the change process can function as an emotional reward (Kotter and Cohen 2002), but research suggests that in higher education settings, short term wins can demotivate further participation, and, if not authentic, can derail progress (Calegari, Sibley, and Turner 2015; Sidorko 2008). Fortunately, we had cause to celebrate a national award, and one of the first faculty to implement a design challenge won an award at a conference. Aligning to the departmental culture, such awards were announced to all faculty by email, with most faculty responding with a personal note to congratulate awardees.

The frequent discussion of the strategies provided a means to acknowledge and value contributions. This normalized the practice of focusing on engineering education research, a change in power dynamics that provided insight and inspiration. For example, one faculty member who was a bit hesitant, but who became highly engaged once writing was added as a strategy, shared the impact this had on their students, showing significant growth in both writing quality and conceptual understanding. By sharing this outcome with the faculty, others became interested in making similar changes, and they were asked to also present this to the other chairs in the school at a formal dean's council meeting. While such events may seem unlike celebrations in an industry or business environment, in an academic setting, asking an associate professor to present their approach with school leaders was both an authentic and motivating celebration because it suggested those in powerful positions could learn from those in less powerful positions. And, such celebrations can serve as a key piece of the puzzle for motivating faculty to take risks.

Step 7: consolidating improvements & sustaining acceleration

The accumulation of short-term wins authentic to the academic setting shifted both symbols – i.e. priorities and approaches to teaching, and power – i.e. what counts as research, bringing increased credibility to the change process, a key aspect of consolidating improvements and sustaining acceleration (Kotter 1996). With this, more faculty became involved ('most of the faculty who teach in the undergraduate curriculum have made changes to their teaching' [GT, I3]).

Kotter (1996) also emphasized that employees should be developed, promoted, and hired with the change in mind. In addition to ongoing professional development, during faculty searches, the learning scientist met with candidates to assess their potential fit with the new culture. Promotion deserves special attention, compared to organizations. While new hires may be selected in part based on their fit with departmental culture, faculty who were hired prior to the change may be vulnerable during this process. And while some junior faculty are eager to implement new strategies, others may feel risk in doing so, especially at a research university where they were hired largely based on their potential for research success. To manage this, the chair did not require junior faculty to implement strategies, but did encourage them to participate in professional development

workshops. In contrast, tenured faculty seeking promotion represent an opportunity to review power dynamics in the form of norms and policies. Such faculty typically have greater autonomy in making their case for promotion, even at research universities, though the norm at our institution had been to base arguments almost entirely on scholarly activities. Allowing faculty to make a case based in larger part on their teaching and their research on their teaching represents a systems change tied to both power and symbols in our department.

Step 8: anchoring the changes

Anchoring changes involves normalizing the new culture and approaches, linking these to success, and planning for succession (Kotter 1996). Prior to the third year, some faculty expressed skepticism and felt that it would be sustained only 'if the institution believes this is a priority' (FacUnd, I2). However, in the third year, the department chair detailed institutionalized changes related to symbols: holding summer retreats for faculty focused on teaching, teaching writing in research-aligned ways; and symbols, people, & power: including undergraduates in planning and teaching courses; viewing the project as 'part of everybody's job' (GT, I3) and embedding non-engineering faculty – first the learning scientist and then a writing instructor, in the department. Faculty noted they had come to view education research as real research – reflective of both power and symbol shift – and felt committed to the new approach to teaching writing, in part because the education research allowed them to understand how and why it is successful.

There have also been opportunities for succession planning, and these are inextricably connected to the change. For instance, the chair described a trip to give a seminar on his technical research, where he also made new engineering education connections. He explained that because of the project, people now schedule meetings with him to 'trade ideas' about engineering education, something that had not happened before the project began (GT, I3). As other faculty who are developing as leaders attend technical conferences, they seek out more information and connections related to improving student learning, something they did not do before the project began.

Conclusions and implications

Previous studies of Kotter's change model in higher education have mainly focused on change efforts outside of faculty teaching and departmental culture (Penrod and Harbor 1998; Wentworth, Behson, and Kelley 2018). Our study contributes to the current literature by presenting analysis of the fit of Kotter's eight steps in a particular academic department. We found creating a sense of urgency was straightforward because it aligned to the grant-seeking culture of higher education. Likewise, forming a guiding team was straightforward because of the requirements of the NSF call and more generally because of the clearly visible authority structure of an academic department. Forming shared vision and strategies required interdisciplinary collaboration among guiding team members. While communication strategies are relatively simple in a department compared to many organizations, communication is not sufficient if the change is unfamiliar and requires experiential learning to see its potential. Because we had removed a key barrier – ensuring engineering education research would count toward scholarship – this provided a means to support faculty to study the impacts of their new teaching approaches. In contrast to past research on Kotter's change model in higher education, we found that short-term wins were important as they enhanced the credibility of the change process, helping to sustain acceleration; this difference may be attributed to the authenticity of our short terms wins. While organizations may be able to manufacture short-term wins that are accepted by the members, the wins in academia need to align to expectations for tenure and promotion. Finally, by changing the culture, the current and developing leaders encountered and sought new opportunities to make further changes. Providing empirical understanding how Kotter's eight steps function in higher education settings paves the way for greater engagement of both researchers and practitioners in settings that depend on stakeholders who possess high autonomy.

As our analysis was of a single department, consideration of structures, symbols, people, and power provides insight into the potential transferability of our approach. Aligning to expected incentives, extramural funding sufficed to create a sense of urgency. The department included a leadership structure and chair whose capacity to lead a change project was enhanced by departmental faculty and team members' perceptions of his credibility. In turn, this makes power salient in the chair's capacity to manage disciplinary hierarchies endemic to collaboration between engineering and social/behavioral scientists, and later, technical writing experts. Through this collaboration, engineering faculty came to see opportunities in shifts in symbols – i.e. the means by which they conveyed the discipline to students. This was enhanced by aligning to incentives, as faculty published the results of these changes, in turn shifting somewhat the power dynamics between research and teaching. This analysis reveals that much depended on the chair's management of power, but to understand both how commonplace this is, as well as how different power dynamics intersect with change, further research is needed.

Examining our use of Kotter's model in light of notable concerns – faculty autonomy, the top-down and deterministic nature of the model – and considering contextual factors elucidated a means to retain the accessibility of Kotter's model while mitigating concerns. Based on our findings, we generalized a *design-based change model* for guiding change process in higher education (Figure 5). This empirically-derived model merges DBIR (Fishman et al. 2013) with Kotter's change model, emphasizing the iterative nature of change processes and providing guidance on trajectories for departmental change, while retaining the accessibility of Kotter's change model. We feel this addresses key shortcomings of Kotter's model as applied to higher education settings, namely that dissemination is an important motivator in such settings, that faculty retain autonomy, and that top-down, deterministic, linear, sequential models like Kotter's can covertly structure thinking and reporting of process, even those that happened in an iterative fashion (e.g. Guzmán et al. 2011).

In the *design-based change model*, we grouped change activities into the four foci of DBIR – vision, plan, implement, and sustain – as we found that within each foci, these activities may happen in parallel or recursively. For instance, as vision and strategies are formed, it is critical to reconsider the team members and evaluate the proposed strategies in light of identified needs. In our own project, when we added a focus on technical writing, we recognized that we lacked the expertise on our team to reach our vision, and this led us to add team members, who then shaped strategies. Thus, we drew activities from Kotter's model, like building a guiding team, and integrated them into these four foci. We omitted steps, such as create urgency, that we found to be endemic to the context and incentive structure.

Dashed lines on the *design-based change model* also reflect the DBIR approach, in that modern design process models typically encourage revisiting and iterating on prior steps. While the typical depiction of DBIR does not reflect this, it is clear from both texts describing DBIR and reports of DBIR that it should be and is carried out in this fashion (Ford, McNally, and Ford 2017; LeMahieu, Nordstrum, and Potvin 2017; Theobold et al. 2019). Iteration is central to design processes, providing an opportunity to learn from failure, and a joint expectation of safety to try and improvability. For instance, when faculty first tried a complex approach, there was often an implementation dip, but with support to analyze and understand more about learning, they were able to refine their approach successfully. However, the locus of iteration proposed here goes beyond what would be found in DBIR, where iteration is typically focused on refinement. Major additions to the strategies – in our case, adding a focus on technical writing – play a key role in fostering ownership of change in a context noted for individual autonomy.

Aligning to the incentive structure of higher education, there are numerous potential dissemination points in the *design-based change model*. First, in *vision,* characterization of the problem and needs could constitute a publication. Second, each iteration implemented could result in reportable results on how faculty perceptions and practices changed, how students engaged, and what their learning or persistence outcomes were. Third, a design case, detailing the process of developing innovative curricula or pedagogy could provide insight for other faculty. Fourth, a retrospective account,

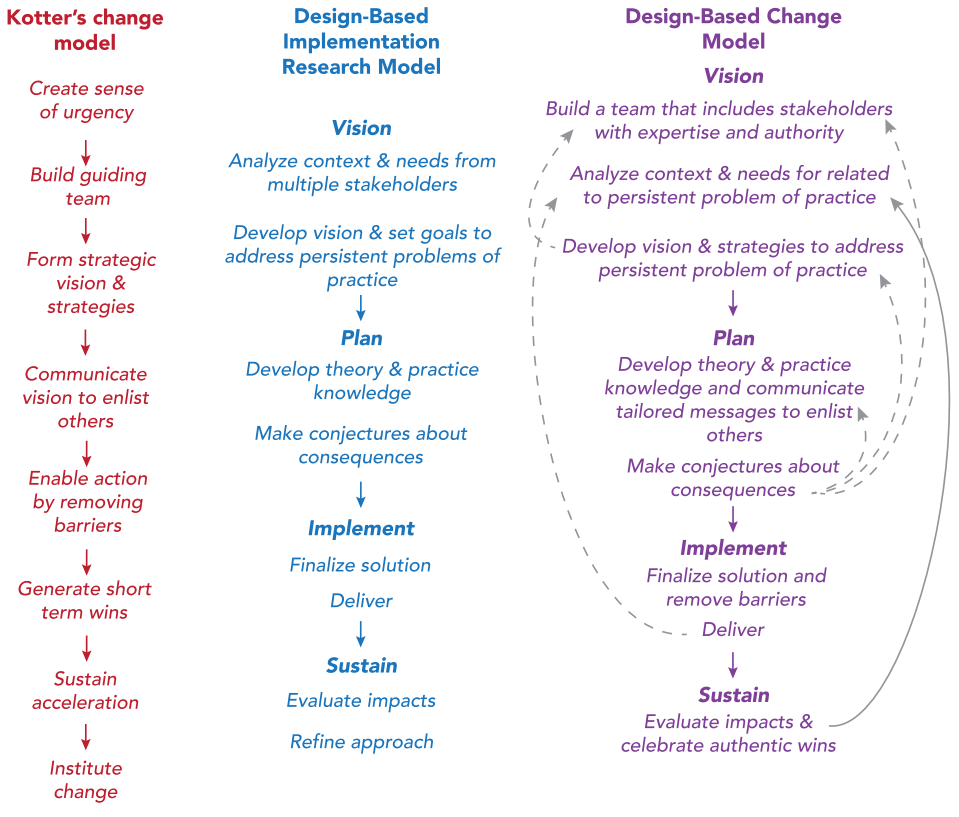

Figure 5. A framework for guiding university change processes that merges design-based implementation research with Kotter's change model.

like this one, can provide insight into the change model used or the effectiveness of particular strategies. Kotter's model, because it was developed for business settings, does not provide such clear opportunities for publication and broader dissemination. Private companies are likely to treat successful change as a competitive advantage, and therefore, their insights about change remain proprietary. In contrast, dissemination is incentivized by both research culture within higher education settings and by funding agencies, and this reinforces participation in the change process, from creating sufficient urgency through sustaining change.

Limitations and future directions

While conducting this study in a single institution provided an opportunity to address noted gaps in the literature about Kotter's change model in higher education (Wentworth, Behson, and Kelley 2018), it also creates limitations and suggestions for future studies. First, this study reports on just three years of a change process, a relatively short time for change in higher education. We anticipate that further iteration will take place. Future research will document the degree to which the changes are sustained, including through leadership turnover and new faculty hires.

Second, while our data collection provided opportunities to triangulate across sources and over time, we were not able to interview all faculty every year. Doing so would have created strife and added to the sense of burden related to the change process. Although faculty meetings provided a window into changes in each member's beliefs about many aspects of the process, the presence of the learning scientist and change management specialist may have influenced their behavior.

Additionally, non-tenured faculty may have censored themselves in the presence of tenured faculty. Future research in varied settings should focus on issues of power, including by providing greater opportunities for data collection by a more neutral party. Such studies could shed light on the applicability of Kotter's model, or of our proposed *design-based change model* in departments with more visible power dynamics (i.e. larger numbers of non-tenure line faculty, fewer women and faculty from groups underrepresented in faculty ranks).

Third, the specific context of our setting – a Hispanic-serving research institution with external funding – means that our findings, while transferable because of the detailed account, may not be generalizable to other change efforts, even within higher education. Notably, we would expect that top-down, mandated change processes that originate external to the department or that operate across many departments would occur differently than we have depicted. Likewise, the credibility of the chair enhanced success. Our methods did not allow us to examine such effects, and further research could address such impacts by conducting cross-site comparisons. Specifically, studies could investigate the degree to which departmental structures (e.g. how faculty come to occupy departmental leadership roles other than chair) relate to their willingness to take part in change initiatives. Contrasting various structures and degrees of trust in chair leadership could predict the potential for successful change. Similarly, the intersectional nature of power (e.g. gender, race, seniority, disciplinarity, and other characteristics) may mean chairs, in a department with different dynamics, may be less able to mitigate power imbalances. Future studies should clarify this, especially by more directly considering frameworks focused on power.

Further research could address some of these limitations by taking advantage of the many NSF-funded change projects underway in engineering departments nationwide. Even those not guided by Kotter's change model could be analyzed using his model as a lens. Specifically, studies could investigate the degree to which the opportunity associated with a grant deadline created sufficient sense of urgency for change across the change projects; how well the requirements for the guiding team served each change process; how many departments treated the strategies as improvable and whether this fostered additional buy-in; relatedly, how many planned to iterate and actually iterated; whether communicating strategies was important but insufficient to create understanding; and to what extent authentic short-term wins were celebrated and aided in sustaining change. Such analysis could establish the applicability of Kotter's model or of our *design-based change model*. An investigation into the role of iteration in published accounts of Kotter's model as used in higher education could further inquire into whether iteration occurred but was not reported, then investigate how and when it occurred and why it went unreported.

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