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# Implicit Theories of Change as a Barrier to Change on College Campuses: An Examination of STEM Reform

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For three decades there have been calls for change and reform in undergraduate science, technology, engineering and mathematics (STEM) education, yet little progress has been made on the various proposed changes, such as scaled up, student-centered approaches to teaching, altered gatekeeper STEM courses, better orientation through bridge and first-year experience programs, and scaled undergraduate research, among other proposed reforms (American Association for Advancement of Science, 2011; Howard Hughes Medical Institute, 2009; National Academies, 2010; National Science Foundation, 2010). Connolly and Seymour (2003) suggest that one of the reasons that reforms have not been successful (particularly in reaching scale)

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is a faulty theory of change driving STEM reform. The dominant model assumed by funding agencies, national organizations, and major initiatives focuses on funding individual faculty innovators to test and create reforms in hopes for dissemination. In the last decade, this theory of change has been thoroughly challenged as unsuccessful (Austin, 2011; Fairweather, 2009). More recent initiatives have begun to utilize more robust theories of change that have been identified as successful for scaling change, such as supporting networks or learning communities of faculty to implement and spread reforms (Kezar, 2011).

In addition to broad changes that are attempted nationally, many STEM reform efforts are more local and occur at the institutional level. These local reform efforts are also guided by theories of change that receive little examination as to whether the ideas held by reformers are robust and lead to scaled changes. In fact, we know little about the theories of change that drive reformers on individual campuses – both for STEM and non-STEM related initiatives. In the general literature on change, there have been few studies that examine change agents' implicit theories of change and how these may impact their ability to implement change processes (Saunders, Charlier, & Bonmay, 2005; Weiss, 1995). This is a particularly important issue when engaging change agents that do not have a track record of working to implement changes, such as STEM faculty. While implicit theories can impact any change agent's ability to create change, novice change agents are likely to have less experience to guide and modify their implicit theories of change; therefore, their implicit theories may have even more consequence on their ability to create change (Dweck, 2009).

In this paper we examine a project aimed at better understanding the theories of change held by reformers on 11 campuses that were involved in a statewide STEM reform project. Campuses were identified that were interested and had been involved in creating STEM reforms and wanted to broaden and scale their efforts. The project leaders helped campus teams to articulate their visions and goals for STEM reform, considered their approach to implementing such changes (i.e., implicit theories of change), presented ideas from research about how changes can be implemented successfully (i.e., explicit theories of change), and helped to facilitate and guide the campus teams over a three-year process. Through our involvement with the campuses for three years, we were able to determine how they initially conceptualized change, how this impacted their approach or ability to change, and the ways that their implicit theories of change were altered over the course of the project.

The importance of the study lies in providing empirical evidence for the often tacit concern among leaders and evaluators of change projects – that change agents' views can serve as a barrier to implementation and success

of changes. In addition, the study provides evidence of ways that implicit views can be modified to garner greater success in change.

### LITERATURE REVIEW

The overarching theory used to frame the study is Weick's (1995) sense-making theory illustrating that organizations are social constructions that various individuals constantly create and re-create as they make meaning of their work lives. As Weick wrote about change processes, he emphasized that people within organizations discover their own invented reality; therefore, they need to undergo processes that help them to understand the proposed change. Understandings of the world are typically tacit or implicit – not part of the consciousness of individuals. So to alter these views, processes must be put in place to make people aware of their implicit views and provided opportunities to examine, challenge, and alter their views. The processes that Weick identified were called sensemaking and sensegiving. Sensegiving focuses on the actions of individuals to help others in understanding the proposed change, which might take the shape of strategic planning, forums or discussions, or speeches (Weick, 1995). Sense-making is the activity of individuals who interact with the sensegiving processes (e.g., strategic planning) and work towards altering their views of a phenomenon. For example, with teaching, if you want to help change a faculty member's view of teaching, then you need to help them make new sense, moving from considering an organized lecture as good teaching to instead viewing the integration of the scholarship of teaching and learning, assessment, and technology as component parts of good teaching. Such a change might happen through sensegiving mechanisms of professional development. While research has demonstrated the importance of sensemaking/sensegiving around a specific topic or phenomenon of change, there has been far less attention to change agents' implicit theories about how change occurs and how these might inhibit or enhance their ability to create change. In this article, we build on Weick's work and examine change agents' implicit theories of change to see how they shape their ability to move change forward. We also examine the ways implicit theories of the change process (rather than the target or focus of change) can be altered, which has not been the focus of any research to date. Sensegiving typically focuses on the content of change.

#### *Defining Explicit and Implicit Theories of Change*

The literature provides generic definition of theories of change captured in Connolly and Seymour (2003): a theory of change is a predictive assumption about the relationship between desired changes and the actions that may produce those changes. Putting it another way, "If I do *x*, then I expect *y* to occur, and *for these reasons*" (pg. 1). Connolly and Seymour also note: "Theo-

ries of change matter because they are usually implicit, and what remains unseen cannot be questioned” (pg. 1). Much of the literature on theories of change does not note whether authors are referring to explicit or implicit theories, but they are distinctly two different phenomena.

Policy and evaluation scholars make a clear distinction of implicit and explicit theories. Explicit theories of change are well formed – explaining how and why a time-bound intervention in a prevailing situation or context is likely to work. Explicit theories of change have thorough categories of information defined and articulated. For example, a robust theory requires the development and articulation of a number of essential elements, such as clearly specifying the long-term goal that a particular strategy is working towards – if the goal is vague, then any analysis of how and whether it will be achieved will also be vague (Saunders et al., 2005). Preconditions hypothesized as necessary for the achievement of this long-term goal are fully articulated in a causal pathway (Hill & Betz, 2005; Saunders et al., 2005). Policy and evaluation researchers articulate very precise elements of theories of change that are reflective of explicit theories of change.

Implicit theories of change, as Connolly and Seymour (2003) allude, are much more the norm among people in organizations, in which individuals tend to be unaware that they have a particular belief about how change occurs, nor do they tend to examine these beliefs. In this paper, we focus on clearly articulating that we are looking at implicit theories of change. Because we are studying a population that does not typically engage in systematic change processes, we were aware that they were unlikely to have developed explicit theories of change. An implicit theory of change differs from an explicit theory of change in that it acknowledges that individuals lack consciousness about their mental constructions and have not been engaged in a process to examine them (Dweck, 2009). We will refer to a theory of change that has been reflected on and integrates research on change as an explicit theory of change. One of the foci of this research project was to transition change agents from implicit theories to explicit theories of change by providing opportunities for them to examine and perhaps change their theories.

### ***Implicit Theories about How Change Occurs***

Most studies of implicit theories of change are related to individual changes such as coping with trauma, aging, or growing and developing from youth to adult (Aber, Brown, Jones, Berg, & Torrente, 2011; Collins & Clark, 2013; Finkelstein, Quaranto, & Schwartz, 2014; Freedman et al., 2006). Only recently has research from the area of evaluation and policy on implicit theories of change focused more broadly on organizations and groups (Cavanaugh, Feldman, & Hertzog, 1998; Haselton & Buss, 2009; Ramanath & Ebrahim, 2010). The research from evaluation tends to focus more on organizational changes and is more aligned with the focus of this study than research from policy,

which examines implicit theories of policy implementation. Therefore we use the evaluation literature on implicit theories of change to frame this study.

Evaluation researchers have examined implicit theories of change as they track change processes in real time and identify the problems that emerged among innovators (Hill & Betz, 2005). Evaluation researchers first identified that implicit theories of change exist and drive the implementation of reform activities (Madaus & Kellaghan, 2002). They then began to identify the characteristics often typified in metaphors that were used by change agents to better describe and make these implicit assumptions more explicit (Saunders, Charlier, & Bonamy, 2004; 2005; Madaus & Kellaghan, 2002). For example Saunders et al. (2005) identified three metaphors – enclaves (i.e., change happens in specific subcultures from the bottom up), bridgeheads (i.e., change happens because of an oppositional culture that challenges the dominant organization), and embedded practice (i.e., change happens because daily routines are modified).

Next, evaluation researchers articulated how a crucial factor in designing successful reform efforts is making change agents conscious of implicit change theories, challenging them, and reformulating their views into explicit theories of change. (Connell & Kubisch, 1998; Zenios, Goodyear, & Jones, 2004). This line of evaluation research demonstrates that one powerful way to improve the chances that a set of activities or program of action will succeed is to help the organizers explore their theories of change and specify the reasoning behind their theories of change (Connell & Kubisch, 1998; Sullivan & Stewart, 2006; Weiss, 1995). Engaging in this set of practices can expose predictive assumptions that do not hold up for various reasons. Among the most common pitfalls are not basing implied or stated theories of change in reality or evidence, failing to consider plausible alternate explanations, relying on limited perspectives, and basing them exclusively on strong affective commitments (Connell & Kubisch, 1998; Sullivan & Stewart, 2006).

### ***Altering Implicit Theories***

Although the overall study was guided by sensemaking, two other theories guided our work on altering implicit theories of change: constructivism and organizational learning (Cavanaugh, 2000; Senge, 1990; Weick, 1995). Constructivist theories of learning suggest that in order for individuals to learn they need to engage in learning experiences – abstract forms of learning will be unsuccessful in helping people to alter their perspectives (Cavanaugh, 2000; Connell & Kubisch, 1998). We recognized that simply describing incorrect implicit theories of change and providing more research-based approaches to change would be unlikely to shift or alter the perspectives of the change agents. Constructivist theory suggests that individuals will need to engage in an experiment with change processes, and once they hit a barrier, they will be more open to examining alterations in their perspective. In

addition to learning from experience, facilitators can provide simulations, case studies, role plays, or other types of experiences that allow change agents to re-examine their belief about change. However, we recognize that authentic experiences with change are hard to simulate, change situations are very context dependent, and it is hard to re-create authentic experiences that replicate the real types of challenges that they will face (Weick, 1995).

A secondary set of literature that guided our work on altering implicit theories is organizational learning. The organizational learning literature tends to focus on how change agents can use data and information to challenge their beliefs about how change occurs (Senge, 1990). The focus in organizational learning is on the way that data and information can be used to help foster doubt in current beliefs, challenge existing assumptions, and help people to consider different and new constructions of how change occurs. Organizational learning suggests that experiences are not necessary (such as engaging in a change process) in order to alter views of the change process. Organizational learning has not been utilized to study learning about or altering implicit theories of change, but it seems a relevant and appropriate framework for thinking about whether we could use data and information to promote changes around implicit theories of change. We wanted to test the assumption of whether data and information on how change has been documented to occur would be sufficient to help people alter their implicit theories of change or whether they would need to undergo certain experiences as suggested by constructivist theory.

In summary, this study focuses on the following research questions: Do faculty and administrative participants in a project aimed at STEM reform hold implicit theories of change? If so, what are they? What interventions (e.g., presenting explicit theories of change, experience paired with explicit theories of change) help STEM faculty and administrators to question implicit theories and shape explicit theories? The study is framed by theories of sensemaking/sensegiving that demonstrate that people use mental constructions to understand their organizational world, including how these organizations change. The literature on theories of change suggests how people make sense of and interpret how change happens. The literature identifies the value of explicit theories of change because they reflect the complexity of change and enable change agents to be successful. Literature on implicit theories of change empirically documents how people often hold unconscious ideas about change (which are often faulty) that can prevent them from being effective change agents. Two theories suggest ways to intervene to alter change agents' views. Organizational learning suggests the value of presenting data and information about explicit theories of change. Constructivism articulates that the presentation of explicit theory needs to be paired with experience.

## METHODS

This study utilized qualitative methods to follow the 11 campus project teams over three years as they initiated, implemented, and attempted to sustain their change efforts related to different STEM education reforms. Studies by evaluation researchers of implicit theories of change typically utilize qualitative methods including both observation and interviews, but they primarily focus on observation, as implicit theories typically cannot be articulated by people.

### *Overview of the STEM Reform Project*

A national organization focused on STEM reform obtained a grant to help campuses both envision and implement scaled changes. The aim of the project was not just to help implement the reforms but also to create an learning tool called a “comprehensive institutional STEM Education Framework<sup>1</sup>” to help campus leaders translate national reports on STEM recommendations into scalable and sustainable institutional actions that improve recruitment, access, retention, learning, and completion for all students in all STEM disciplines. The project moved beyond prior efforts that might focus on a single change, such as implementing undergraduate research, instead exploring connected and complex strategies that would meet the reform aspirations of these national reports. Such large scale changes would require: 1) deliberate planning, prioritizing, and collaborative leadership; and 2) identifying and modifying institutional infrastructures that impede the change process. The national STEM reports rarely come with campus-level recommendations, instead leaving the work of translating these STEM reform ideas onto campuses and the process of implementing changes up to campus change agents. Therefore, the goal of the project was to help campuses in creating an approach to change that could implement a complex series of STEM reforms advocated within the national reports.

From each campus, we recruited a team of individuals involved in the STEM reform and asked that it be a cross functional team with faculty, administrators, and an institutional research staff member. Because use of data would be one of the primary parts of the change process, we wanted to ensure that teams had access to data through the institutional researcher. The teams were typically 5 to 6 individuals but expanded over time as the project was implemented. The total number of individuals involved in the initiatives across the campuses was 77 (55 faculty and 22 administrators/staff).

The learning tool (or framework) was created at the beginning of the project but only as a draft document that campuses could utilize and then

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<sup>1</sup>See Appendix A for original example framework provided to assist participants with the change process.



modify based on their own experiences with change, lessons learned, and the collective wisdom across the 11 campuses. Because little research exists on how to best implement STEM reforms on college campuses, the project aimed to utilize the experience of these campus-based teams to construct or create a change framework. The tool articulated an explicit theory of change, based on prior research about making the institutional level changes at colleges and universities. By providing this explicit theory of change, we hoped to alleviate common challenges and make campuses more successful. The framework included: advice for developing a vision based on landscape analysis, information about garnering leadership and managing teams, ideas for collecting and reviewing data to develop a vision and assess capabilities and readiness, sample interventions and problems they address, institutional challenges around rewards or policies, assessment techniques, and politics.

The 11 campuses were chosen purposefully to be a diverse sample of four-year higher education institutions in California. They included six California state institutions, two research universities, one elite private liberal arts college, and two private, regional liberal arts colleges. Each of these institutions were chosen because they have some prior STEM reform efforts that they could build on and were in equivalent places in the change process. They had implemented some efforts but had minimal scale and a smaller number of reforms that they wanted to build on. Therefore, the campuses are typical in terms of their progress compared to other institutions nationally and diverse in terms of their contexts. Campus context can often shape or impact change processes, so we wanted diverse institutions types to examine potential institutional context differences. We also wanted institutions that were typical in terms of their efforts around STEM reforms so that the frameworks that emerged could be instructive for other institutions.

### ***Data Collection: Observation & Interviews***

The main data collection method for this study was observation because implicit theories are not understood by participants and therefore could not be ascertained through interviews. As participants moved farther along in the project and began to recognize their implicit theories of change and challenge and alter them, interviews could be used to capture these changes, but most of the work to identify implicit theories needs to be garnered through observation. One of the main tasks of the project was to fill out the framework by addressing the questions within it about vision, leadership and team assets, landscape, data, interventions, assessment, and politics.

As a part of the project, the 11 campuses were gathered for annual meetings over 2–3 days to describe the evolution of their vision and goals for STEM reform, their ideas for approaching implementation, barriers and challenges that they faced, and lessons learned. At these annual meetings, we worked to collect and identify their implicit theories of change and also

provided ideas for reconsidering their implicit theories of change. We met regionally with subgroups of the campuses in San Diego, Los Angeles, and San Francisco once a year to check in on their progress and address the same set of questions around changing vision, implementation, and barriers and challenges. In addition, project facilitators also visited individual campuses when requested to meet with the teams and help address questions or concerns. Lastly, we hosted monthly webinars where we presented data to support both the campuses' changes and change processes including such topics as supporting underrepresented minorities in STEM, using data analytics to support change, assessing student learning, and sharing case studies of institutions successfully engaging in STEM reform. In addition to the webinars with specific content, we also had opportunities for open discussion among the 11 campuses in our monthly webinars. At the annual meetings, regional meetings, and webinars, field notes were taken about implicit theories of change, recognition of implicit theories of change, and alterations in implicit theories of change and development of explicit theories of change. Also, in addition to field notes, project meetings involved creating posters about project progress, building Lego models to represent intended directions for change, and creating other artifacts that were analyzed for theories of change.

Three times during the projects we interviewed team leaders and/or project teams in order to understand their individual challenges and opportunities that might not be communicated in our group settings. The interviews also provided an opportunity to further understand implicit theories of change by listening to the change agents' rationale and approaches for their work. Interviews were informal, largely unstructured, not guided by a protocol, and typically lasted 45 minutes. We encouraged teams to join interviews, but project teams varied based on schedule and availability.

### ***Data Analysis, Trustworthiness, and Limitations***

The field notes from the three years of meetings and webinars as well as the interviews were analyzed using Hyperresearch. We utilized a grounded theory approach for data analysis since we were interested in inductively understanding the implicit theories of change provided by individual change agents and groups of change agents (Charmaz, 2006). Rather than impose metaphors from earlier studies of implicit theories of change, we allowed the data to inform us about participants' specific implicit theories. In order to understand and analyze implicit theories, we looked for those statements (e.g., we feel that grass-roots faculty leadership is most effective) and actions their teams exhibited (e.g., an overreliance on grants would be reflected by most of their activity focusing on developing grant proposals) – particularly in the first year and a half during which we tried to determine a baseline of implicit theories. In order to make a designation as possessing the implicit theory among the project team, we used the following criteria: 1) More than

half of team members described or enacted the implicit theory; 2) Multiple statements and behaviors were identified; and, 3) These statements or behaviors were exhibited at several meetings/ opportunities for interaction such as webinars.

In order to analyze changes over time, we phased in interventions and documented shifts in statements and behaviors as a result. We use the following criteria to designate recognition of implicit theories and changes in implicit theories: 1) Team members described questioning or doubting a former implicit theory; 2) Team members described being aware of a belief that they had not been formally conscious of; and 3) Team members began to articulate explicit theories of change we introduced in the project. We also attempted to use the criteria above related to multiple team members demonstrating an awareness of their implicit theory. However, we did not always find that shifts in thinking could be held to the standard of being exhibited at multiple meetings or among the majority of team members. As the project ended at three years, new explicit theories were beginning to be the norm for teams and exhibited much more often but had not fully replaced the norm among all teams. One deductive assumption that guided our analysis was an examination of whether data and information (from organizational learning) or experience (from constructivist learning theory) helps guide people more towards challenging their implicit theories of change. This deductive analysis was used to phase in the interventions and track changes.

Common strategies like member checking were not possible because the individuals we were studying would not always be conscious of their implicit theories of change. Instead, field notes were taken by two separate researchers and compared to ensure greater reliability. Similarly, data was reviewed by and analyzed by separate researchers that compared their interpretation of the field notes and interviews. Third, detailed field notes (often referred to as thick description) were developed, which also ensured greater trustworthiness.

There are a few limitations to the study. During the course of the three years, some of the teams had turnover with faculty or staff leaving the institution and taking sabbaticals or other forms of leave (approximately seven people). This turnover meant that some people had different exposure to the explicit theories of change, simulation activities, and varied amount of experience implementing the STEM reform. In a real-life setting these types of alterations are common and unavoidable. We also could not observe team meetings that occurred on campus. Most campus teams met monthly as they moved their projects forward. We asked the campuses to develop reflective memos to describe their activities and monthly meetings as well as asked them to provide summaries at key phases of the project. However, we found that project teams did not have the time and were unwilling to provide regular write-ups and documentation about their meetings. After being unable to obtain the memos, we stopped collecting them halfway through the project.

Therefore we are limited in understanding the on-campus conversations and how they reflected implicit theories or transitions in their implicit theories.

## FINDINGS

We briefly describe an overview of the findings, followed by a section that reviews the implicit theories of change that prevented participants from adopting our explicit change framework and end with a section on data about what helps campuses in moving beyond their implicit theories of change. In describing the implicit theories of change, we note some that seemed particular to STEM faculty members. While previous studies of implicit theories have not examined or suggested that certain groups might orient to certain implicit theories, our findings suggest that the background of various change agents may determine the type of implicit theories they develop and that this is an important new line of research to better understand the barriers to particular types of change agents.

Over the course of the three years, all teams faced significant challenges in filling out the framework (our explicit theory of change) and using it to facilitate the change process. Concerns emerged early on with understanding what it means to develop a vision or set of goals for STEM reform, understanding what it means to conduct a landscape analysis examining data to identify problems with student success, and framing their proposed changes and linking them to the institutional context. Many of the aspects of the framework were confusing to project teams at the initial meeting, and continued to be challenging to them even after we conducted phone calls with campuses, visited campuses, and conducted regional meetings for them to learn with and share from each other.

As we moved into year two, campuses continued to face challenges in utilizing the framework; therefore, we asked them to try engaging in the change process in whatever way they could, but we returned to the framework at the annual and regional meetings as a way for them to conceptualize the work they were doing in year two. In the third year of the project, teams started to be able to utilize the framework to move their efforts forward. While still facing challenges, concepts outlined in the framework began to make sense as they were implementing changes and had experience with the concepts outlined including leadership, politics, difficulties getting data, and carefully aligning interventions to goals. In the third year, they began to challenge their implicit theories about how change occurs, which had prevented them from embracing and using the framework in the first two years.

### *Implicit Theories Shared with other Change Agents*

As we observed campuses struggling to utilize the explicit change framework, we attempted to understand what was preventing their ability to use

concepts such as vision, distributed leadership, champions, supportive institutional infrastructure, data-driven decision-making, assessment, and intervention alignment. Over the course of the first year in particular, we were able to document implicit theories of change, which appeared to prevent them from utilizing or engaging these many proven and robust principles from the change literature. While we do not have space to describe all of the facets of their implicit theories of change we provide some examples that illustrate: 1) Problematic implicit theories found within the literature; and 2) Problematic implicit theories that appear to be particular to STEM faculty. Not every campus team expressed each of these implicit theories, but these were fairly common across the overall project. Table 1 summarizes the most prevalent implicit theories of change across the various campuses.

**1) Change can be Meaningfully Created by Starting with Interventions; Understanding the Problem is Not Necessary.** The evaluation literature describes the challenge of change agents believing that they can jump directly to a strategy or intervention without much exploration of the problem or issue (Connolly & Seymour, 2003; Weiss, 1995). However, research demonstrates that changes can be more successfully executed when there is alignment between the strategy or intervention and the type of change, which requires some exploration into the focus of change itself (Kezar, 2001). For the projects we were engaging in related to student success, this would require the campuses to first understand why students are not persisting or graduating before developing interventions. But similar to the research on evaluation, the participants in our study (seven out of the 11 campuses) – using their implicit theories of change – believed that change could meaningfully occur by jumping straight to a strategy or intervention. For example, we saw campuses develop a bridge program to support students who were not successful without understanding who the unsuccessful students were on their campuses. Another campus set out to make changes in the first year experience assuming challenges were a result of problems transitioning between high school and college. However, data illustrated that the significant retention problems were in the sophomore year, and their focus had been misguided by jumping straight to interventions.

**2) Change is a Rational, Not a Political, Process.** Also similar to the evaluation literature, we found campuses' (eight of the 11) implicit theories of change suggested that change is a rational process<sup>2</sup> and does not involve

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<sup>2</sup>It might seem contradictory that they did not use data to develop interventions while they at the same time over relied on data for moving the change process forward. What we identified was a disconnect in using data for persuasion with others but not to inform actual intervention choices and decision-making. Part of the dilemma with unidentified implicit theories is that logical inconsistencies are more likely to exist.

**TABLE 1**  
**SUMMARY OF FINDINGS ON IMPLICIT THEORIES HELD BY PROJECT TEAMS**

| Project Team | <i>Implicit Theories Reflected in Evaluation Literature</i> |                                      | <i>Implicit Theories Specific to STEM Faculty</i> |   |  |
|--------------|---|--------------------------------------|---|---|--|
|              | Change can occur by beginning with an intervention          | Change is rational and not political | Change is either bottom-up or top-down            | Meaningful change happens only at the department level change | Data alone can convince people of the need to change |
| Team 1       | X   |                                      | X   | X   | X  |
| Team 2       | X   | X                                    | X   | X   | X  |
| Team 3       |   | X                                    | X   | X   | X  |
| Team 4       | X   | X                                    | X   | X   | X  |
| Team 5       |   | X                                    | X   | X   | X  |
| Team 6       | X   | X                                    | X   | X   | X  |
| Team 7       | X   | X                                    |   | X   | X  |
| Team 8       | X   |                                      | X   | X   | X  |
| Team 9       |   | X                                    | X   | X   | X  |
| Team 10      | X   |                                      | X   | X   | X  |
| Team 11      | X   | X                                    | X   | X   | X  |

NOTE: X indicates theory was held by members of the team.

politics (Madaus & Kellaghan, 2002). Change agents assumed that if they were armed with data about why students were not succeeding, then others on campus would be persuaded. They did not anticipate or prepare for politics, even though we described the political nature of change throughout the first year of the project. One of the campus teams describes this issue:

We spent the majority of our time creating really robust data systems and running really compelling reports that we sent around to various departments and institutional leaders to demonstrate where we were having problems in student success. What we didn't anticipate is that different people would start blaming each other, that groups would start pointing fingers, and that no one would actually pay attention to the data as it relates to student success. Then we began to realize and think back about how you mentioned politics are important to change processes.

**3) Change is Either Bottom-Up or Top-Down.** The role of leadership and change processes demonstrates the need for both bottom-up and top-down leadership often epitomized by shared or distributed models of leadership for optimal scale and success (Kezar, 2001). Yet, we found that the participants typically had implicit theories of leadership as being only successful if bottom-up (seven out of 11) or top-down (three of 11). Only one of our campuses came to this study with a more distributed view of leadership for change. Those who maintained a bottom-up view systematically ignored the broader campus infrastructure and ran into significant problems. Those who took a top-down orientation typically ran into problems with buy in. An example from one campus illustrates this point. One campus had garnered a lot of bottom-up support among faculty for rethinking gatekeeper courses; however, to fully implement the change meant alignment with other courses in the curriculum and the involvement of administrative leadership to provide the rewards and incentives for faculty who taught in other areas to participate in the initiative. Also, the campus needed resources to support professional development for the gatekeeper courses. But since they were focused only on bottom-up changes, and did not think about ways to integrate changes from the top, they kept encountering barriers to moving forward.

### *Implicit Theories Particular to STEM Faculty and Administrators*

We also identified implicit theories that seemed particular to these individuals' unique positioning as STEM faculty.

**1) Meaningful Change happens at the Departmental Level, Not the Institutional Level.** For faculty in the sciences, the department is the dominant organizing unit. Most STEM faculty remain isolated from the rest of the campus and they tend to be quite independent and autonomous from even other departments. Engineers, chemists, biologists, and mathematicians live in separate department-based worlds. The initiatives that we were working



with related to student success required an institutional perspective so that factors from advising, to articulation policies, to admissions, to co-curricular experiences, to supplemental instruction, to classroom instruction are all addressed. However, because their implicit theories of change constructed the world as defined by the department, that made it extremely difficult for these faculty members to consider and utilize levers for change outside of the department or even construct a vision for STEM student success beyond the department. All teams involved with the project had implicit theories of change revolving around the department. As a result, we witnessed teams that consistently could not envision changes that went beyond classroom instruction or professional development at a local level. Even considering ways to bring in professional development from centers for teaching and learning when their initiative focused on professional development became problematic. In addition to not being able to envision broader changes to support student success, their implicit theories of change ignored all of the institutional level issues that needed to be leveraged to create change from policies, rewards and incentives, institutional data collection, infrastructure, and administrative leadership. One campus change agent articulated this departmental bias: "I just do not see how we can envision this change beyond the department. That is the meaningful unit of analysis in STEM."

**2) Data Alone can Convince People of the Need to Change.** While the evaluation literature suggests that change agents' implicit theories tend to ignore politics, faculty in STEM tend to over-rely on data as persuasive for motivating others to be involved in the change. In addition to ignoring politics, STEM faculty downplayed the human dynamics (e.g., developing personal relationships for persuasion) involved in change and assumed data and research would drive the change process. Therefore, their implicit theories of change relied heavily on data and research as the pivotal strategy. While our project encouraged the use of data as part of the change process, we noticed the over reliance on data early on as people described where their efforts were focused – building data infrastructures, creating more robust data reports, developing more technical approaches to data about student success, and so on. As one team member noted: "I am confident that data will drive this change process and convince people to change." While all of this is valuable work, the over reliance on the strategy and the lack of work spent on human interactions such as creating champions, developing leadership skills, and fostering relationships to access resources and support suggested that they would encounter problems, which they later did.

**3) Funding is Necessary to Engage and Support Any Change Effort.** While funding and resources are central to any change effort, STEM faculty also showed an over reliance on the need for funding to move any initiative forward. Given the prevalence of funding in STEM for research, faculty



are accustomed to obtaining large sums of money to support their work in labs, for example. Their implicit theories of change reflect a focus on obtaining substantial funding to ensure progress and see large sums of money as necessary for change to occur. STEM faculty's experience is that acquisition of funds move activities forward. This implicit theory was observed as most campuses focused a great deal of time on writing proposals to obtain grants. One participant described this issue: "I'm just sure if we don't get a large amount of outside money then no one will be interested in doing this work no matter how good an idea it is. So that's where the team is focusing its efforts – writing grants." Another campus expressed this issue: "Well we had a really good idea for STEM reform but I don't see any funding in that direction so we've developed a new idea that's aligned with getting possible funding." So this focus on funding even altered the direction of their change efforts. Whenever we asked campuses about support that we can provide to the project, the most common response was help in developing grants, connections in order to get grants, ideas and opportunities for obtaining grants, and strategies for acquiring grants.

### *Ways to Change Implicit Theories*

Table 2 summarizes our introduction of interventions to alter implicit theories of change and the progression we saw among project teams. We had three different phases of the project: 1) Description of explicit framework only; 2) Simulated experiences through case study and webinars added to framework; and, 3) Campuses worked on creating change in order to pair experience with the framework. The first year of the project aimed to see progress they could make with only a low level intervention of providing them with an explicit theory of change through the framework. Our incoming assumptions suggested that providing an explicit change theory in the framework may not be enough to overcome implicit theories of change. However, we tested this assumption by initially presenting the abstract ideas about how change can be promoted on college campuses. Findings from this first phase showed little to no progress among teams in becoming aware of or challenging implicit theories or developing explicit theories of change. This suggests that the presentation of an explicit theory alone may not be enough to create learning.

Next we moved to phase two, the framework paired with experiential learning or activities that simulate experiential learning. Constructivist research suggests simulations with experience might help change agents to question their implicit theories of change. This resulted in some challenging of implicit theories of change. Lastly, we had teams start moving forward with their change processes to pair their learnings with the framework. It is in phase three where we saw the most progress among teams. Yet it is important to note that we may have just seen more progress here because more time had

**TABLE 2**  
**ALIGNMENT OF INTERVENTIONS TO AWARENESS OF AND SHIFT IN IMPLICIT CHANGE THEORIES**

| <i>Year of Project</i> | <i>Intervention</i>  | <i>Shift in Implicit Theory</i>  | <i>Adoption of an Explicit Theory of Change</i>  |
|------------------------|--|--|--|
| Year 1                 | Introduce explicit theory of change in framework; end-of-year activities to simulate experience  | No awareness of implicit theory or shift   |  |
| Year 2                 | Begin to implement framework (planning period over, engaging in initial experiences with change process); continue activities to simulate experience | Five project teams can be observed to question their implicit assumptions, particularly as experience is added to simulation activities                    |  |
| Year 3                 | Continue implementation of framework; teams gain experience  | All project teams become aware of their implicit assumptions; 9 of the 11 teams reflect changes to several dimensions of their implicit theories of change | In the third year of the project, those with the most progress implementing change developed explicit theory of change (7 of 11 teams) |

passed and not because of the intervention itself. While there is an association, there can be no causal link made and this is based off our observations and self-reports of campus teams.

Tables 2 and 3 provide a summary of the ways that campus teams became aware of their implicit theories, altered their implicit theories, and how seven of the 11 teams eventually created explicit theories of change by the end of the project. The next two sections below provide more detail of these findings. While we did not have a control group that did not utilize the framework that outlined an explicit theory of change alone, data gathered through the interviews and observations demonstrates how experience alone would not have led to teams changing their implicit theories of change and suggests the importance of the framework in the process.

**Activities to Simulate Experiential Learning paired with the Framework (Explicit Theory).** In order for change agents to become more aware of implicit theories and to develop explicit theories of change, we used case studies, simulations, and role-play examples from successful campuses and other vehicles to make the ideas more tangible. While change agents may eventually learn from experience, having some activities up-front to try to embed the learning earlier is important. Learning from experience can take a long time, and campuses can use activities to speed up the learning process. Additionally, learning from experience can result in mistakes that might seriously compromise the change process. So while experience appears to be the most powerful teacher, it may come at a significant cost if solely relied upon.

We observed five project teams that became aware of their implicit theories of change after two to three webinars, in which activities simulated experience. We distributed several case studies related to implementing STEM reforms, and we invited speakers to discuss and make the kind of changes we were asking participants to engage in more concrete. While not as rich as learning from experience, some participants did note the value of the case study and simulations, and we saw some shifts in understanding during the beginning of year two after the detailed case studies were presented in webinars. In the words of one campus team member:

It's one thing to read a case study but another to hear the leaders on campus discuss what they went through. I found hearing the experiences of the faculty on other campuses made me start to question the way we had been dismissing the need for data or examining our problems on campus. We just sort of jumped to an intervention. I don't think I even realized that's what we've done, but it really made sense the way they methodically examined the issue and systematically aligned the intervention.

Key lessons from the case studies about approaches to using data to identify problems in student success, the importance of distributed leadership, and

TABLE 3

**SUMMARY OF RECOGNITION AND ALTERATION OF IMPLICIT THEORIES AND EVIDENCE OF ADOPTION OF EXPLICIT THEORIES OF CHANGE**

| <i>Project Team</i> | <i>Implicit Theory Recognized</i> | <i>Theory Implicit Altered</i> | <i>Participants' Comments Indicating Adoption of Explicit Theory</i>  |
|---------------------|-----------------------------------|--------------------------------|---|
| Team 1              | X                                 | X                              |   |
| Team 2              | X                                 | X                              | Change is a complex phenomenon that involves determining readiness, creating a vision through careful analysis of data, the distributed leadership, analysis of infrastructure, and changes in policies to support STEM reform  |
| Team 3              | X                                 | X                              | Change involves strategy, working with people, working through politics, the vision in-line with institutional priorities, assessment of needs and stealth implementation   |
| Team 4              | X                                 |                                |   |
| Team 5              | X                                 | X                              | STEM reform requires an institutional change strategy that utilizes a careful landscape analysis, well aligned interventions, and understanding of institutional challenges, assesses assets and weaknesses, and careful use of assessment  |
| Team 6              | X                                 | X                              | Success in STEM reform means having carefully outlined goals and assessment of institutional problems and challenges, review of core strategies and interventions, creating champions and leadership, navigating politics and designing an intervention that people enthusiastically implement and assess                                   |
| Team 7              | X                                 | X                              | Change is driven by a vision aligned with institutional priorities and is embraced by change agents on campus that review data to support the vision and determine interventions, like reformed gatekeeper courses that are institutionalized and help to spread a culture of new practices   |
| Team 8              | X                                 | X                              | Change requires distributed leadership that involve significant faculty development, the appropriate resources and infrastructure, and an understanding of institutional data about student success   |
| Team 9              | X                                 |                                |   |
| Team 10             | X                                 | X                              |   |
| Team 11             | X                                 | X                              | STEM changes require institutional level changes that utilize multiple strategies that are matched to identify problems or challenges determined through understanding the institutional assets and challenges through an enthusiastic team that helps develop greater leadership, appropriate resources, and support and navigate politics |

NOTE: X indicates phenomenon occurred for that team. Blank cell in last column indicates that an explicit theory was not adopted.

the importance of making professional development fun and engaging led to project teams voicing questions about their current perspectives. On phone calls and at regional meetings in the second year we observed five teams describing their theory of change differently as a result of the simulated experience: “Measuring learning is important to ultimately seeing the value of our change,” and “I can see the value of a team of both administrators and faculty working together,” and “Change is a human process, and it is important to get to know people and understand what would motivate them to support student success.”

**Experience Helps in Driving Changes to Implicit Theories, but it is Insufficient if not Paired with Explicit Theories of Change that are Robust.** For most campuses in the project, encountering significant barriers illustrated the importance of the explicit theories communicated as part of the project that were not absorbed when merely discussed at project meetings. By the end, nine of the 11 project teams were able to utilize experience combined with the framework to recognize and alter their implicit theories and develop more robust theories of change. We described the importance of using data to define the problem, being aware of politics, and aligning the intervention with the problem, but until campus teams encountered a problem on one of these areas they tended not to question their implicit theories. In addition, they tended to operate outside of the framework we provided for them until they experienced a significant barrier, which made them question their change process and return to the framework to see if it had any answers related to the barrier they were experiencing. Experiencing problems helped them question their implicit theories. However, having a tool – the framework – as part of the project to consider the barriers meant they were able to overcome them compared to previous times they encountered barriers and just became trapped. Interviewees described the value the framework provided from past experiences in change.

One campus provides a strong example of how experience paired with a framework helped them to recognize and challenge their implicit theory of change. During the third year of the project at one of our regional meetings, a campus team described their evolution and awareness:

We were really stuck in the first year and a half, we didn't have a clear vision for what we're trying to achieve, we didn't know who we should be working with, and we couldn't conceptualize the types of institutional infrastructure needed to meet our not well articulated goals. We then began to have discussions that helped us recognize that we were focused completely on funding to the exclusion of even having a vision that we could sell to get funding. And strangely enough, we had this discussion and said we need a theory of change. And we know you have talked about the framework, but we never realized it was a theory of change. So we went back to the framework and combined it with our struggles and experiences. And we began to articulate for ourselves, what we thought were the important components of creating change. To talk

about it. We described the importance of faculty development for sustaining and keeping changes going and how we would build this kind of robust faculty development. We began to really articulate the kind of infrastructure support in terms of administrative leadership, physical space, fundraising, etc.

On another campus, some of their early implicit theories of change were aligned with the framework and they were moving quite quickly. They gathered and analyzed data related to student success, helped build more robust data systems and were able to identify key places where students were dropping out and experiencing problems. However, when they went to department chairs to share the data and work to develop interventions, they began to experience resistance. The framework outlined the needs to develop coalitions and champions among key groups like department chairs, but it was not until they experienced significant resistance that set them back for about eight months that they began to re-examine their implicit theory of change focused mainly on data-driven decision-making and see the need for developing champions and addressing politics. As the faculty member described:

I remember we had discussions at the first few meetings about the need to create distributed leadership. In fact we talked about that a lot but it just didn't sink in. It wasn't until the department chairs threw up their arms that I returned to the idea of distributed leadership and started to recognize its importance and rethink the way we were approaching the reform.

## DISCUSSION

This study sought to understand the role of implicit theories of change in inhibiting change agents' success. In addition, it examined a range of approaches (e.g., utilization of a framework, the framework paired with activities to simulate experiential learning, and experiential learning paired with the framework) for recognizing their implicit beliefs and altering and developing more explicit theories of change. One contribution of the paper is the identification of STEM specific implicit theories of change, demonstrating that different groups with varying levels of experience may have unique implicit theories. STEM faculty's implicit theories of change were driven by their experience of being isolated within their departments and disconnected from their institution, coming from heavily rationalistic and data-driven disciplines, and relying heavily on funding to promote their work, particularly research.<sup>3</sup> These three defining aspects of their experience

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<sup>3</sup>Some may suggest other fields and disciplines might be strongly data driven, departmental in orientation, and funding focused. These findings may be relevant to other faculty and not STEM specific, but they were clearly evident among our participants.

shaped the implicit theories they brought to change processes. While data and funding are certainly important aspects of change, the over reliance on these aspects can sidetrack and create barriers for change agents. The narrow lens on the department for creating changes, particularly ones focused on student success, severely handicapped change agents, who missed out on important levers available at the institutional level.

It is particularly important to understand the implicit theories of STEM faculty because they may reveal why reform efforts on campuses have been particularly slow and unsuccessful. The findings from this study can help to guide institutional efforts around STEM reform moving to more robust theories of change by challenging these problematic implicit theories around the dominance of the department and overreliance on funding and data. These are likely similar problems on other campuses not a part of this study and can be more adequately challenged now that they have been brought to awareness. Other pockets of slow change on college campuses can also be examined for implicit theories of change that might be slowing efforts and specific stakeholders' implicit theories. However, this finding is not meant to suggest that all implicit theories are "irrelevant" or without value. We are concerned about unexamined implicit theories that are not examined through evidence for their efficacy. For example, some campuses may find that funding is critical for infrastructure issues needed to move a change forward. But to hold this belief without checking whether it is true for the situation or campus is the problem we are trying to expose.

Second, STEM faculty also share implicit theories with other change agents that have been a part of earlier research such as ignoring the politics of change, seeing leadership as exclusively top-down or bottom-up, and jumping to interventions without fully understanding the type of changes needed. While these were only a sampling of some of the implicit theories possessed by the participants in our projects, they suggest the range of implicit theories that inhibit change agents across sectors. Again, these same implicit theories can be examined in other initiatives and provide a place to anchor future research and policy efforts.

Third, there has been very little investigation about ways to help change agents recognize and alter their implicit change theories. Our data are only suggestive in this area, as we had no control group and cannot identify causation. The study provides evidence that more constructivist approaches to learning, in which individuals need to take concepts they learn and utilize them in experience in order to fully understand the concepts (or the theory of change), can be effective. Organizational learning theorists suggest that individuals might be given information or data about change processes (similar to what we provided in the framework) and be able to alter their implicit theories of change; this study does not provide evidence of this as-

sumption. It may be that learning about the how change process operates is a phenomenon that is particularly in need of experiential learning or grounding. Certain concepts where people do not develop strong implicit theories might be altered through organizational learning approaches or among more experienced, less novice groups.

This research documents three strategies for challenging implicit theories of change and helping change agents to develop more robust, explicit theories of change. The literature suggests that challenging implicit theories will then lead to change processes moving forward more smoothly and ultimately to reforms being implemented rather than blocked. Our first intervention of reviewing an explicit theory of change alone did not appear to help campus leaders examine implicit theories. The framework paired with facilitated experience was associated with the most examination of implicit theories. Activities that simulate experience paired with the framework appeared to be less robust but also seemed to help campus leaders challenge their implicit theories. While the framework paired with facilitated experience and/or activities that simulate experience may not be the only approaches that can be used, the study does demonstrate these strategies may help change agents to examine and challenge their implicit theories. While this is only a first step in the change process, it is one that has been identified in earlier studies as important to reforms being successfully implemented.

### ***Future Research and Conclusion***

If we were to redesign this study (and have no constraints from funders) we would include control groups with varying levels of treatment to alter their implicit theories of change and ascertain their success rate. Such studies are extremely difficult in education because funders do not want funding to go for partial implementation and prefer to have as much of an impact as possible. Our data indicated that past efforts at change had become stalled once participants had experienced barriers, and in this project the framework appeared to allow them to continue moving forward, suggesting that experience alone is not enough to help change agents move forward. However, unless an experimental design study is conducted with a control group with no treatment, no casual connection can be made, so we can only make the claim in this article with caution, noting limitations.

It will be important to examine other groups to see other distinct variations in their implicit theories of change. The implicit theories of change among STEM faculty appeared to be largely shaped by the norms of science disciplines about the prevalence and importance of the department, the dependence on grant funding for most work and activity, and importance of data and rationality. Other groups that might be interesting to study on college campuses include other disciplinary groupings (e.g., humanities,



social sciences) and different units or divisions (e.g., student affairs vs. academic affairs).

We did not find notable differences in terms of implicit theories or processes for recognizing and altering theories to differ by institutional context. It seems that many of the implicit theories are generated around more generalized concepts of strategies, leadership, and politics related to change rather than specific dynamics on campuses. Yet, more focused case studies that have researchers embedded on particular campuses might better understand that nuance within institutional contexts. Because the researchers were not located on the campuses for significant amounts of times and were involved with the campuses in many settings that focused on cross-campus experiences, this may have muted out important contextual differences.

In conclusion, the study helped explore an area with limited research to date. While an emerging body of research exists from the world of evaluation about the way implicit theories of change inhibit progress, these concepts have not been brought into the organizational change or education literature in substantive ways. We hope that this study will lead to more research, particularly around the ways to help change agents recognize and alter their implicit views to ultimately be more successful.

# APPENDIX A

## ORIGINAL DRAFT FRAMEWORK INTENDED TO ASSIST PARTICIPANTS IN THEIR CHANGE PROCESSES

### STEM Education Change Framework

**Vision:** The draft Framework below contains suggested categories of key dimensions of campus work as well as possible questions to guide campus work. Example responses to some questions have been provided to prompt team discussions.

| Dimensions: In what key areas does the system need to work to achieve this vision?   | A. What does change look like?   | B. What are the goals and measurable outcomes?  | C. How will we know we are successful? What benchmarks will be used?  | D. How are we doing? Where are the gaps (leadership capacity)? What are the challenges (politics, buy in) we face? | E. What interventions will we need to implement to reach our goals and vision?   | F. How will we operate and learn as an organization?   | G. How will we document our progress and success?   |
|--|--|---|---|--|--|--|---|
| <b>1. Institution Learning and Leadership</b><br>a. mission and educational purpose<br>b. organizational learning<br>c. campus culture<br>d. policies and procedures, including faculty rewards and incentives | <ul style="list-style-type: none"> <li>Mission statement that contains language regarding STEM student success vision</li> </ul>   | <ul style="list-style-type: none"> <li>Increase graduation of underrepresented minority (URM) students in STEM</li> </ul> | <ul style="list-style-type: none"> <li>Collect and monitor graduation rates</li> </ul>  | <ul style="list-style-type: none"> <li>Currently, only 30% URM students graduate in STEM</li> </ul>                |  |  |   |
| <b>2. Faculty work related to educational mission/objectives</b><br>a. quality of learning<br>b. assessment<br>c. program design<br>d. pedagogy<br>e. program culture<br>f. faculty development                | <ul style="list-style-type: none"> <li>Clearly articulated learning outcomes</li> <li>Assessment plans developed</li> <li>Assessment data are regularly reviewed, used in program involvement</li> </ul> |   | <ul style="list-style-type: none"> <li>Establish learning outcome statements</li> <li>Review course syllabi</li> <li>Inventory courses for pedagogies employed by faculty members</li> <li>NSSE data</li> </ul> |  | <ul style="list-style-type: none"> <li>Faculty learning communities</li> <li>Send faculty to professional development meetings and institutes</li> </ul> | <ul style="list-style-type: none"> <li>Advisory committee with representatives from CTL and science college will be created</li> </ul> | <ul style="list-style-type: none"> <li>Regular progress reports to campus community</li> <li>Write case study for framework project report</li> <li>Submit manuscript to journal</li> </ul> |

Appendix A, cont.

**STEM Education Change Framework**

**Vision:**

The draft Framework below contains suggested categories of key dimensions of campus work as well as possible questions to guide campus work. Example responses to some questions have been provided to prompt team discussions.

| Dimensions: In what key areas does the system need to work to achieve this vision?                               | A. What does change look like?  | B. What are the goals and measurable outcomes?  | C. How will we know we are successful? What benchmarks will be used?  | D. How are we doing? Where are the gaps (leadership capacity)? What are the challenges (politics, buy in) we face? | E. What interventions will we need to implement to reach our goals and vision? | F. How will we operate and learn as an organization?  | G. How will we document our progress and success?  |
|--|---|---|---|--|--|---|--|
| <b>3. Student Success</b><br>a. measures of success<br>b. support programs<br>c. co/extra-curricular experiences | <ul style="list-style-type: none"> <li>STEM student success goals have been defined</li> <li>Support programs are aligned with goals</li> </ul> |   | <ul style="list-style-type: none"> <li>Collect and monitor retention rates, transfer rates, completion rates by race, major, etc.</li> <li>Cost analysis of course failure</li> </ul> |  |  | <ul style="list-style-type: none"> <li>Use data for department discussions regarding student success goals</li> </ul> | <ul style="list-style-type: none"> <li>Present results of evidence-based program improvements at professional conferences</li> </ul> |
| <b>4. External stakeholders and partners</b>   | <ul style="list-style-type: none"> <li>P-16 STEM council with local K-12, business and civic leaders</li> </ul>                                 | <ul style="list-style-type: none"> <li>Stakeholders are involved in programs</li> </ul> |   |  |  |   |  |

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